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SPEECHES AND ARTICLES BY/ON DR. JAMES A. SHANNON

Volume II

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TAB 26

NATIONAL COMMITMENTS AND INSTITUTIONAL RESPONSIBILITIES*

II. The Commitment to Expand Scientific Training and Research (Outline)

James A. Shannon, M.D.**

I. Appreciate opportunity to meet here and explore the vital and provocative question of our national commitment to expansion of scientific training and research.

   A. It is an opportunity to document and delimit this commitment, and to establish a background for consideration of institutional responsibility.

   B. Since Dr. Beadle will address himself to the second part of the theme--the question of responsibility, or impact upon higher education--I will try to confine my remarks to the commitment as such--its origin and nature.

II. Concept of national commitment to scientific effort is profound and complex, grounded in tradition, embodied in law.

   A. As a Nation, we have increasingly accepted the view that our component institutions--private as well as public--are responsible, to a greater or lesser extent, to the people.

   B. Indeed, social control of institutions and groups, as well as their own sense of social responsibility, dictate that they shall serve the Nation in attaining national goals--intellectual, cultural, humanitarian, economic, military.

   C. With respect to science, general recognition of its potential and importance has been tantamount to a mandate upon major organizations to take up the challenge of research and technological development.

   D. The commitment extends to many types of institutions and to an appropriate development of the resources essential to expansion of the scientific effort.

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*Meeting of American Council on Education, Washington, D.C., October 3-4, 1963.

**Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

E. It is a commitment reinforced by law, implemented by funds from all sectors of the economy, controlled by cooperative interests of many groups.

F. Its importance lies in nothing less than the fact that intellectual capability has become in our time the definitive measure of a nation's strength.

III. Historically, scientific research in America developed along relatively independent lines in educational institutions, the Federal Government, and industry. There has been a gradual increase in collaboration among these groups, particularly in financing the basic scientific endeavor.

A. Prior to World War II, the Nation frequently drew upon science at times of crisis, but recognized little commitment to pursue research on a continuing basis.

1. The Civil War forced the Government into the use of experimental science to evaluate technology.

a. National Academy of Sciences formed--scientific advisors to Government.

b. Another lasting result was an expanded Army Medical Department with its library, now PHS's National Library of Medicine.

2. The threat of epidemic disease brought laboratory investigation into the Public Health Service in 1887.

3. From 1900 until World War I--the "Progressive Era"--the commitments grew firmer.

a. Prevailing mood favored active Government policy toward problems emerging from industrialization, urging national management of natural resources.

b. Relation of Government to large-scale industry was such that science was called upon increasingly. Establishment of Bureau of Standards, Bureau of the Census, Food and Drug Administration.

c. As in the past, however, spontaneous progress in basic science, mainly in universities here and abroad, was considered sufficient. No organized effort to expand the stockpile of knowledge.

4. World War I brought new focus on Federal-private relationship.

a. National Research Council emerged as central scientific agency. Big negotiator, with private and public support.

b. But again, the end of the crisis brought retraction of the Government's science and defense efforts, with exception of some expansion in social science fields.

B. Two demanding conditions called forth a new basic science effort in 1940s--an effort that has since been sustained.

1. Increase in chronic disease, which had given rise to the National Cancer Institute in 1938 and was to call forth eight more Institutes at the National Institutes of Health.

2. The war itself, with strong appeal to the scientific community and impressive evidence of the importance of research.

a. Office of Scientific Research and Development, through contacts with universities and research grants, undertook to turn scientific resources to weapons development and other wartime needs.

b. Federal expenditures for R & D rose to $1.6 billion by 1945. Scientific manpower had become limiting factor; remains so.

c. Recognition of a continuing need for science is seen in President Roosevelt's request of Vannevar Bush to propose a program for postwar support of research and training. Bush's answer was the superb "Science--The Endless Frontier" (1945), leading to NSF (1950).

d. And Hiroshima and Nagasaki imprinted indelibly the significance of science on the public mind, leading directly to AEC (1946).

e. To some extent, the sustained nature of the commitment has resulted from recognition of the need to replenish the stockpile of knowledge, for which we were once indebted to European tradition.

IV. Since the midcentury mark, new patterns have again formed in the conduct and support of science. The Nation's commitment has deepened.

A. Between 1950 and 1963, all R & D rose from $2.9 billion to $18.5 billion. More rapid growth than GNP.

B. Federal share went from $1.2 billion to $14.7 billion, rising as a proportion of all R & D. In 1940 less than 1% of Federal budget went for R & D; now 15%.

C. Federal Govt. supports 60% of all research conducted by industry (1961) and over 70% of separately budgeted research in universities (1958).

D. Of $736 million spent for R & D in colleges and universities in 1958, $538 million came from Federal sources. Physical sciences in the schools received 90% of their support from the Government; engineering, 85%; life sciences, 50%; and social sciences, 48% (source: NSF).

E. It is clear from these figures that the Federal Government has become by far the main source of support for the Nation's scientific effort, and that industry and the universities share strongly in the performance of research.

1. National security is the primary need behind this situation.

2. Medical research has kept pace with R & D, remaining about 7% of the total.

3. There is every indication that expansion of Federal programs has stimulated private research spending.

V. The trend since 1950 toward increased dependence of the Nation's science on Government support has established commitments of another kind.

A. No longer can it be said that the Government's commitment is merely to support research itself. It must now help to extend and maintain the Nation's resources for research--facilities and trained manpower.

B. Balance is lacking among the resources of science.

1. Education at all levels lags behind the opportunity and support of research itself.

2. The general environment for research--facilities, resource centers, science administration--has not been favored to the same extent as the individual research project.

C. The Federal Government is committed to help redress these imbalances and help sustain science at a level commensurate with the opportunity and national need.

1. Raises the question, what <u>is</u> research? how extensive?

2. Narrow view sees only formalized study and publication, but realistic view encompasses spectrum of activities.

a. Stimulation and encouragement of capable young people to pursue research careers, and support of education after interest is generated. Research cannot be separated from education.

b. Construction of physical resources.

c. Financial support for projects, institutions.

d. Problem of manpower, facilities and funds are continued impediments to full progress.

3. In this spectrum, there is ample challenge and opportunity for both Federal and private programs.

D. Foundations and voluntary agencies often raise the question whether they should continue to support research in view of large Federal investment. Answer--

1. Federal, private are complementary, not competitive.

2. Diversity of support is safer.

3. Diversity of viewpoint, variety of advisers, difference in objectives--all constructive.

E. The remaining private sector--institutional and industrial--is committed to a continued high level of performance and to prudence and probity in the use of public funds. There must also be a sharing with government in long-range efforts to establish a stable basic research structure.

V. In addition, there is the need for a stronger voice on the part of schools.

A. The university is primarily concerned with advancing education and protecting scholarship.

B. It is responsible for maintaining a salutary balance between education, research, and community service.

C. Just as industry must respond to the social demand for better control of drugs, environmental poisons, etc., the university must respond to its own sense of purpose, which is the best way it can serve the Nation in the long run.

D. The universities as a group should take a more active part in forming national policies in scientific research, education and development.

E. In accepting public and private funds to conduct research and research training, the university has committed itself to viewing with perspective the Nation's science program and to participating actively in the control of its destiny.

TAB 27

SPECIAL ARTICLE

MEDICAL CARE: ITS SOCIAL AND ORGANIZATIONAL ASPECTS

The Place of the National Institutes of Health in American Medicine

JAMES A. SHANNON, M.D.

SPECIAL ARTICLE

MEDICAL CARE: ITS SOCIAL AND ORGANIZATIONAL ASPECTS

The Place of the National Institutes of Health in American Medicine

JAMES A. SHANNON, M.D.*

BETHESDA, MARYLAND

IT is fitting that the *New England Journal of Medicine* should include the National Institutes of Health among the topics of a series dealing with social, economic and organizational problems affecting medicine today. This is quite within the tradition anticipated in the prospectus for the forefather of the present journal — the *New England Journal of Medicine and Surgery* — when it appeared in January, 1812. "The pages of the Journal," the prospectus stated, "will always be open to the accurate observer of nature, the useful experimenter, and the rational theorist." It is in the role of "useful experimenter" — in an extended sense of the term — that the National Institutes of Health might appropriately be represented in the present context.

A TRADITION OF RESEARCH IN MEETING NATIONAL HEALTH NEEDS

The National Institutes of Health has deep historical roots. The spectacular growth of federal research programs in recent years has obscured the fact that the soil was long and carefully tended and the recent flowering less abrupt than some might suppose. A brief examination of the roots of the National Institutes of Health may place the organization in proper perspective and enhance understanding of its role and its problems.

It was the Civil War that brought the federal Government into medical research and gave the country its first medical institute — the Army Medical Museum. Over the years such eminent workers as John Shaw Billings and Walter Reed helped to establish the Museum's reputation and to make it for some time the principal medical research institute of the nation. To the same period belongs the Public Health Service's Hygienic Laboratory, founded by Joseph Kinyoun. Predecessor of the National Institutes of Health, the Laboratory grew slowly, concentrating on problems of infectious disease.

It will be recalled that in the latter part of the nineteenth century the federal role in medical science was largely limited to problems involved in the control of epidemic disease. This was consistent with the predominant needs and the state of the art, as well as the prevailing views on the proper scope of government. Still, the federal medical investigator, restrictive though his research mission was, made important contributions to science and the public health.

While Joseph Kinyoun was isolating the cholera organism — for the first time in this hemisphere — Reed was contributing to the pathology of typhoid fever. When Reed and his colleagues were working on yellow fever they collaborated with Henry Carter, of the Public Health Service, who was able to demonstrate the length of time required for the mosquito carrier to become infective after feeding on a victim of yellow fever. And just as Gorgas, applying Reed's methods, made possible the construction of the Panama Canal, so the Public Health Service organized an effective mosquito-control program and eliminated yellow-fever epidemics from the United States.

The precipitous decline of infectious and nutritional diseases in this country in the early decades of the present century was in substantial part the consequence of research carried out in federal laboratories. Studies of smallpox, diphtheria, typhoid fever and pellagra come to mind. Such achievements produced an enduring tradition of excellence and productivity in federal medical-research activities.

In the late 1920's the emerging significance and complexity of the chronic degenerative diseases — especially cancer and heart disease — led to a shift of attention in Public Health Service research programs. It was obvious that additional basic knowledge would be needed to control the chronic diseases, and that this could only be derived through programs emphasizing research and research training. Creation of the National Cancer Institute in 1937 marks the beginning of the National Institutes of Health as it is known today. For the National Cancer Act of that year constituted the inauguration of the federal Government's categorical approach to the conquest of disease, and served as a pattern for successive acts of Congress — the Mental Health Act, National Heart Act, Dental Research Act and Omnibus Act (1950) — that form the legislative base of the present institution.

ORGANIZATION AND ROLE OF THE NATIONAL INSTITUTES OF HEALTH

Today there are 9 research institutes at the National Institutes of Health, 7 of which are broadly oriented toward some health problem or group of problems that are the major causes of disability or death in the United States. This categorical struc-

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ture, largely shaped by the nature of the American culture and political processes, has served well the purpose for which it was intended. The suffering and tragedy of premature death associated with cancer and heart disease are powerful incentives to public action. The Christmas Seal drives of the National Tuberculosis Association are the prototype of many successful efforts directed against specific health problems. Thus, the categorical approach has served to symbolize urgent national goals in medical research and to muster necessary resources. In these terms the Congress of the United States has responded to a general consensus for action to study and eliminate the major diseases.

It is important to note that in so doing it has fostered research and training at a fundamental as well as an applied level. This led to the development of fundamentally oriented research in each of the categorical institutes and, finally, to the establishment of the Division of General Medical Sciences in 1958, later to become the National Institute of General Medical Sciences (1962). This action set apart and expanded the grant-making function of the Division of Research Grants, which is now devoted solely to rendering grant-review and administrative services to the various Institutes. The Division of Research Facilities and Resources, created last year, strengthened programs for the support of research construction and development of the research environment of the nation. It is interesting that Congress's recent elevation of the Division of General Medical Sciences to Institute status was done with no emotional appeal concerning any disease, but in recognition of the need for broad, undifferentiated support of the basic medical, biologic and behavioral sciences as essential to progress against health problems.

In addition to the Institute of General Medical Sciences, Congress in 1962 authorized a new institute of child health and human development, which constitutes a significant departure from the categorical disease approach. The new institute will provide a focus for comprehensive and integrated research embracing the complex processes of human development from conception to old age. Indeed, for the first time the National Institutes of Health is specifically charged with investigation of the entire life process. These two new institutes — General Medical Sciences and Child Health and Human Development — extend the scope of the National Institutes of Health programs to include research in virtually all areas relevant to human health.

Implications of Larger Federal Role

Although the direct research activities of the National Institutes of Health in the laboratories and clinics at Bethesda have been highly productive, the federal medical-science programs that have been most influential in the national scientific and academic scene are the extramural operations of the National Institutes of Health: the awarding of grants and fellowships in support of research projects, research training and the development of research facilities. Since World War II the extramural activities have expanded far more than the intramural. Whereas the total intramural appropriation in 1946 was two and a half times the extramural, the extramural in 1963 was five and a half times the intramural. Both facets of the program in fiscal 1963 made $881,000,000 available to the medical-science community.

The expansion of the Institutes since World War II reflects a variety of circumstances and forces. In the first place, the Public Health Service Act of 1944 provided unprecedented authority to conduct and support all kinds of medical research. In the second place, at the end of the war, the residual research-support program of the Office of Scientific Research and Development in the field of medical science was transferred to the National Institutes of Health to administer. And in the third place, there was a high public expectation of what could be achieved through a concentrated scientific effort, as a result of the American success with the Manhattan Project and the first atomic bomb.

The postwar period has been characterized by two other major facts conducive to development of the National Institutes of Health: the expansion of research opportunity afforded through a maturing of the biomedical sciences; and the absence of any nonfederal source of support commensurate with the opportunity and need.

Here, it might be well to point out that the enormous growth in federal research spending, with its profound socioeconomic causes and implications, has left at least two impressions that are seemingly as prevalent as they are erroneous.

One of these impressions is that the nation's present level of expenditure for medical research represents a much higher proportion of total scientific effort than a few years ago. This is not the case. The rapid growth of national expenditure for medical research has paralleled the growth in other science fields. Total national expenditure on research and development has risen from $2,900,000,000 in 1950 to an estimated $18,500,000,000 in 1963. The proportion of these expenditures devoted to medical research has only increased during that time from 5 to 8 per cent.

Another false impression is that the expansion of research in the life sciences is overwhelmingly due to the influx of federal money — that the federal support is indeed "drying up" other sources of support. Again, this is not the case. There is considerable evidence for the view that federal research support has stimulated rather than inhibited private spending. Although federal funds have increased as

a proportion of the total expenditure for medical research the absolute nonfederal contribution has continued to grow steadily and impressively over the years, from about $42,000,000 in 1940 to an estimated $577,000,000 in 1963.

The real importance of this is that medical-research support continues to have a salutary diversity of sources. Moreover, private support is characterized by greater flexibility and freedom of action than governmental, again recommending that the two should be complementary.

Management of Grants

The National Institutes of Health has developed its programs within a framework in which the basic scientific decisions have emerged from the scientific community itself. This has been accomplished through a system that assures both sound assessment of scientific merit through study-section review, mainly by nonfederal scientists, and careful appraisal of program importance by national advisory councils comprising nonfederal leaders in the biomedical sciences and public affairs. These two mechanisms provide a review of grant applications on the basis of scientific merit and help assure that the National Institutes of Health is supporting qualified scientific investigators. Another assurance of quality is that the review at the National Institutes of Health follows a review by the universities and institutions that sponsor applicants for grants. At that stage a number of unacceptable grants are rejected, raising the overall quality of grant applications that NIH receives. The organization is proud of the grants-review system, which constitutes a set of equitable and effective relations.

But the National Institutes of Health is, and must continue to be, a complex and fascinating experiment in federal research efforts. Because it constitutes an ongoing experiment, even the best designed features influence the experiment itself, sometimes in unforeseen ways. For example, under a system of awarding grants on a competitive project basis to scientists who are affiliated with institutions, there is a possibility that these institutions will lose some control over the direction and balance of their research efforts, with a resulting loss in the total research potential.

To assist institutions receiving grants in their efforts to strengthen and improve the research environment, the National Institutes of Health, in 1962, began to make General-Research-Support grants to schools of medicine, dentistry, osteopathy and public health. Such grants will be extended to other nonprofit institutions in 1963. The amount of the grant is determined by a formula that takes into account the amount of the federal and nonfederal research funds available to the institution. To encourage the institutions to seek nonfederal research funds, the proportional award based on nonfederal funds is double that based on federal funds.

These general-research awards are complementary to the project grants. Although they must be utilized in the field of research and research training in the sciences basic to health, they are not committed to any particular research or training project and may be used in the manner that the institutions consider most effective.

Increasing Career Stability and Opportunity

Another system concerns the career stability of researchers in universities and professional schools. Many schools are financially unable to offer full career support to all their research personnel, who are thereby reduced to a grant-to-grant existence. These conditions are not productive of the best work and are not attractive to potential researchers with financial obligations. Research Career awards were therefore instituted in 1962.

The Research Career awards are designed primarily to assure stability of income to researchers whose salaries have been derived from grants and contracts and other short-term sources. The compensation provided is consistent with the salary scale of the institution for persons of equal experience and accomplishments. Two kinds of awards are made: one for five years, renewable, for those in the early years of their research career; and one for the full remaining career of those with substantial experience. Thus, the program represents a shift from a preoccupation with current research to a concern for long-term support for highly qualified scientists.

The scarcest and most invaluable resource at every educational level is faculty. In all programs the National Institutes of Health has made, within the statutory limitations of its powers, every effort to increase and conserve this critical resource. Research-project grants for educational institutions provide increased opportunities for careers in combined teaching and research, and other NIH programs — such as the research career awards mentioned above — are more explicitly designed to assist faculty. Training grants provide substantial amounts to institutions for faculty salaries, equipment, supplies and other items necessary for performance of the training function. In addition, portions of the funds provided under the new general-research-support grants may be utilized for faculty support if, in the judgment of the institution, this is the most effective way to strengthen its medical-research potential.

For a number of years the National Institutes of Health has been acutely aware that adequate and stable funds for support of research in colleges and universities could lead to the complete withdrawal from the teaching staff of some of the best informed and most productive faculty members. NIH has also been aware that if such a process were to

evolve and continue, both the present capabilities of these institutions and the future research resources of the nation would be seriously crippled. The medical schools — the group of institutions attracting the most National Institutes of Health funds — must have the opportunity to select and carry out the essential functions of teaching, service and research while drawing upon all possible sources of financial support.

National Institutes of Health research funds greatly strengthen educational institutions by helping them to attract and hold superior faculty and to provide the intellectually stimulating atmosphere of advancing knowledge, which serves the vital purpose of appealing to the nation's youth.

Several training programs reinforce this appeal by providing for graduate students and postdoctoral fellows in many health-related fields. In 1962 fellowships were awarded to 1527 graduate students and 1419 postdoctoral fellows. In the same year more than 6000 graduate students and 4500 postdoctoral fellows received stipends under training grants administered by the institutions.

But the provision of adequate numbers of faculty, researchers and students, not only to sustain the present research level but to provide the basis for an expanded medical-research effort in the future, is proving to be one of the most difficult problems. Medical-science programs are in the position of having to run as fast as they can merely to stay in the same place, and any great increase in manpower will require the execution of programs that go far beyond those now administered by the Public Health Service. A comprehensive study of the manpower requirements for medical research, submitted by the National Institutes of Health to the House Committee on Appropriations in 1962, indicated that the number of scientists would have to double by 1970. There is no possibility of accomplishing this goal under present federal programs.

Enhancing the Research Environment

Although manpower needs at present and in the future must be one of the areas of greatest concern, any balanced program to increase research resources must also provide increased research facilities, either as new construction or as enlargement of already existing structures. Under the construction-grant program begun in 1956, the NIH has made about 1000 grants for a total of almost $230,000,000. These grants are made on a matching basis up to 50 per cent and have contributed to the construction of new and remodeled facilities costing nearly $1,000,000,000.

Successful as this program has been, it soon became clear that there were some urgently needed facilities that, because of their extremely specialized nature and high capital cost, were beyond the financial capacities of individual institutions. Consequently, the special-purpose Primate Center Program was developed to enable scientists of diverse disciplines to study biologic characteristics in primates throughout their life-span. Grants have already been awarded for six regional and one national primate center, to provide unique facilities for research with primates in a continuing effort to increase the national research potential. Furthermore, the recently initiated Special Resources Centers program has made provision for the construction of computer centers, biomedical engineering centers and other such special research resources not readily available in the institutions where most medical research is conducted. Seventeen computer centers and one biomedical engineering center are already in operation.

Present Problems

As the foregoing discussion indicates, the mission of the National Institutes of Health, although simple and straightforward and intimately connected with the desire of the public for better health, must necessarily be accomplished within the complex framework of a formalistic government and the value structure of society. In the long run, all NIH efforts are based on the co-operation of the scientific and medical community, the Congress and the public. This co-operation is essential to continued success.

What the National Institutes of Health have done so far is to launch a national effort that not only furthers specific categorical disease objectives but also extends broad support to a major sector of science. In addition, they have provided leadership in knowledge and technology that now permits major developmental programs in such areas as cancer chemotherapy, cancer virus studies and vaccine development. These are the encouraging results that one sees from this continuing, national experiment that is the National Institutes of Health.

At present a major series of problems confronts this experiment. One problem is that the furtherance of knowledge becomes increasingly costly, since the Institutes now have the capability for undertaking large-scale experimentation through broad collaborative studies and major developmental efforts. Tomorrow's medical research will predictably require ever more complex instrumentation, greater clinical resources and greater use of the technology of the physical sciences. Although the cost will be high, the promise of payoff is even greater.

Another problem arises from the failure of the nation to provide commensurate support for the educational functions of academic institutions. Large-scale research funds must be prevented from distorting the essential missions of the schools. I have indicated the various measures that the National Institutes of Health has taken — within its legally imposed authority — to offset such a distortion.

Finally, the management of large sums of money has presented particular problems in assuring prop-

er accountability to the public purpose. This has brought sharply into focus the terms of the relations between the federal Government and participating institutions and investigators. The strengthening of administration has encountered the difficulty of maintaining a balance between the conditions of accountability, on the one hand, and the conditions of scientific creativity, on the other. This balance must be carefully preserved. To date, the National Institutes of Health has made certain changes in its procedures, has issued a new detailed manual to improve administration of grants at the institutional level, and has confined financial relations with profit-making organizations to a contract basis.

These are some of the problems of the current scene — incomparably more complex than in former times — to which practical solutions must somehow be found. Such solutions do not lie in any set of circumstances or conditions that existed in the past, however strong one's nostalgia. They must be in positive terms commensurate with the dimensions of the future.

Looking ahead, it is clear that the magnitude and the character of the scientific research program required for the welfare of this nation cannot be supported without continuing, extensive federal involvement. This is true in all fields of investigation, including those that are medically related. With this involvement, these activities will enter an age of biologic research with potentialities dwarfing the advances of the preceding decades in physics. Without this involvement the effort will falter. But federal involvement brings with it a challenge to political skill and maturity in the academic and scientific worlds. For the federal Government must support science without controlling it. Moreover, the federal Government must extend general support to medical and other areas of higher education and must do so without controlling education. These are not easy tasks. They can be accomplished only with the active, continuing participation of informed people, the mechanism for which exists in the form of advisory groups.

Vigorous preservation of the essential conditions for productive scholarship, support for measures designed to sustain those conditions and vigorous objection to measures that threaten the productivity of research and teaching are the keys to maintenance of the essential freedoms. At the same time, the institutions that receive federal money have an obligation to expend it in accordance with the conditions stipulated when they receive it, and to handle federal money with the same care as they do their own.

The institutions will not always obtain all they wish, because of legitimate demands on the part of the Government for the accomplishment of specified tasks and for accountability for funds. But there is no reason why these inherently conflicting demands cannot be reconciled in the future as they have been in the past. The national stake in effective reconciliation is so high that scientists and educators have a deep obligation to participate in the task.

Summary

Medical-research activities of the United States Public Health Service may be roughly divided into three phases: 1887-1937, studies on epidemic diseases; 1937-1947, research on cancer and infectious diseases at the National Institutes of Health; and 1947 to the present, conduct and support of research on a broad spectrum of chronic diseases and basic biomedical problems. The third phase is further characterized by strong emphasis on supportive activities through grants and fellowships and by programs designed to extend the nation's research resources.

National Institutes of Health grant programs have expanded rapidly since 1957, and now support 40 per cent of the nation's medical research, which has kept pace with the growth of all research and development. Meanwhile, private support of medical research has also grown, and funds continue to come from a diversity of sources.

The National Institutes of Health's awarding of grants and development of policy in supportive programs rest formally upon the advice of nonfederal scientists and public leaders. This measure for ensuring quality of program content was recently supplemented by new regulations concerning the management of grants in recipient institutions.

Some of the newer National Institutes of Health support programs are designed to help schools and other institutions develop the research environment and stability of careers in research and research teaching.

Problems now confronting the National Institutes of Health in this continuing "experiment" include the increasing cost of new knowledge, the nation's failure to support adequately the teaching function in schools, and the need to preserve freedom while rendering proper account of public funds in support of biomedical science.

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THE SCIENTIST IN GOVERNMENT - THE DEVELOPMENT OF IN-HOUSE RESEARCH

Growth and Complexity

Recognition of scientific research and development as a crucial and continuing part of the nation's health and security began after WW II.

The impact of science's role in the nation's programs can be gauged by Federal costs for research and development activities -- for to keep pace with the increasing national needs, the percent of total Federal budget expenditures allocated for research increased from less than 1% in 1940 to 13.3 percent in 1963.

National expenditures for scientific research and development now amount to about 15 billion dollars a year. Last year, the U.S. provided 65% of all funds expended for the nation's scientific research and development programs -- private industry contributed 32%. In addition to supporting its own research and development programs, the Federal government supported 2/5 of the cost of private industries R & D efforts.

Government R & D activities are by no means limited to research performed within the Government laboratories. During the past decade, with the entry of the Government into new fields of atomic energy, space exploration and biomedical research, it has been necessary to go outside the Government to find many necessary specialized services and talents. These have been secured from private institutions and organizations through grants and contracts. Although the research is performed outside the Government's laboratories, Federal scientists retain responsibility for the overall planning and direction of the research.

New fields — opportunity to ~~[illegible]~~ —
The federal establishment is not done during
periods of ~~[illegible]~~ attrition → reduction

About ten percent of the professional engineers and scientists in this country are engaged in the Federal government's research and development programs. The Federal establishments constantly face pressing problems in the struggle to keep a fair share of the creative scientific talent which we need to spearhead, stimulate and activate research and development activities so crucial to the national interest.

Implications for Staffing

The most important single factor in the scientific work of the Government is the quality of its scientists who perform its R & D work, and plan and supervise the work performed under grants and contract operations. In terms of the challenges, the consequences for the work and the effects emanating from the work, it is critical that the Government be second to none in attracting and keeping scientists who are outstandingly creative. With the emergence of the contract and other mechanisms for supporting outside research, the manpower needs within the Governmentnow not only require top-flight scientists, but those who also have special management and planning skills in addition to scientific achievements.

Attracting Scientific Excellence

There can be no substitute for setting the highest possible standards and providing the greatest possible inducements for recruiting gifted scientists. There can be no quarrel with the axiom that "quality attracts quality" and it is essential that an organization employ ~~at least a few~~ in key positions highly creative scientists. Such individuals can provide the halo of excellence which will ensure the establishment of a stimulating environment appealing to other creative scientists and inevitably such personalities elicits creativity in others. If an institution is unable to produce an atmosphere conducive to scientific creativity, its position as a prospective employer will be diminished. The

good scientist is eagerly sought after and will be ultimately won by the institution that enjoys professional recognition both within and outside of the organization. When even a few of these scientists find that a particular institution fosters the conditions which are attractive to them, there will be few problems that cannot be successfully met within the organization.

Conditions Fostering Creativity

What are the factors which contribute to or detract from overall ability of the Government laboratory to recruit and retain creative scientists? In addressing ourselves to this question we can profitably look at the experience of a laboratory which has enjoyed more than ordinary success in recruiting and retaining gifted leaders in its field of scientific endeavor

During the past decade the NIH has been widely acknowledged as one of the world's finest centers for biomedical research The NIH stature has been such that service with that Institute is recognized in most scientific circles as the highest possible professional endorsement The reputation was not easily earned, nor is it easily retained. The development of the NIH to its present position of pre-eminence in biomedical research was initially made possible through the action of Congress in authorizing special salaries which allowed the NIH to successfully recruit world renowned scientists for many key positions. The most important stimulus to a creative scientist is another creative scientist; other equally gifted scientists were attracted to the organization. The influence of these scientists on the working environment and administrative climate of the organization has been such that it is now generally conceded that the NIH environment encourages creative accomplishments and provides full opportunities for individual professional growth and recognition.

There was room for adequate growth [illegible]

The Scientist Stereotype - the university environment

What type of environment most successfully attracts the creative scientist? If we generalize, it seems quite clear that some of the most important attractions are those which are part of the university traditions and practices. A major objective of the NIH has been to provide to the fullest extent possible the type of environment which is found in the best universities. There is some evidence that we have been successful in doing this; there is also some evidence that we are slipping. In 1956, our scientists were asked to compare the NIH employment with the university employment on 26 aspects of work. In every item, at least 50% of those expressing an opinion stated that the NIH was about the same or better than the university. More recently, with the gap between university and government salaries widening, more and more of the best NIH research talent are returning to the university environment. While salary considerations are undoubtedly the single more important precipitating factor in decisions to leave the Government service, there is impressive evidence that we may be losing some of our ability to maintain comparability with the universities in areas other than salary. This is illustrated by the results of an exit interview study over a period of one year.

Interviews conducted with 40 departing employees indicated that in general no single reason was finally responsible for the person leaving -- most departees cited several factors which, in combination served to influence their final decision. The reasons given can be broadly classified into three categories:

First, salary and financial considerations. 58% of the reasons fell into this grouping. Most of the departees in this group were

men returning to the university environment to take advantage of increased salaries and opportunities to consult more freely, and to benefit from free educational privileges for their children. This same group also mentioned other extras including better retirement plans, greater leave privileges and superior life insurance and hospital plans.

The second category includes expressed dissatisfaction with the system or mechanics of employment. 22% of the reasons fell in this group. Almost all of the separations reported here are scientists returning to the university life to reestablish academic associations and to benefit from university employment ~~prerequisits~~ including tenure, prestige, faculty club activities, teaching opportunities, etc.

The third group of reasons given fall into the category of management and/or supervisory deficiencies. The separations reported in this category, those citing management and/or supervisory deficiencies, represent for the most part employees who were moving to another environment where they felt they would have a greater opportunity to utilize their professional and/or administrative skills.

These interviews suggest rather forcefully that many of the departees, while quite disturbed over the Government pay disparity, were also unhappy or disappointed in the failure of the Government to provide all of the advantages of the university environment. Of those leaving, ____% returned to positions in universities.

Environmental Elements Contributing to Creativity

If the university environment fosters creativity, it is imperative that we attempt to identify the elements which contribute to creativity and strive to incorporate these into the Federal work setting. Professor Donald Marquis (MIT) says there are three important determinators of scientific creativity:

> First, an intellectually stimulating environment; second, security (but not too much); and, third, scientific and academic freedom. These three elements, in addition to stimulating creativity, also serve to attract those individuals who are creative.

Interestingly enough, an attitude survey conducted at the NIH in 1956 appears to confirm the importance of these elements to the scientist at the NIH. The three elements which ranked highest as to their importance in research were:

1. Interest potential of work
2. Opportunity to do creative work
3. Chance to contribute to knowledge.

The NIH ranking of the above elements are higher than elsewhere in the Government and particularly in industry. All data available indicates that the NIH scientists placed the highest importance on the professional elements of the job as distinguished from economic and social aspects of the job. Items considered to be least important to NIH scientists are:

1. Chance to feel part of the organization
2. Congeniality of associates
3. Social value of work.

The one area that appears to be of over-riding importance and which is NIH's most valued treasure is the opportunity to perform research independently

and freely. In 1952, 1956 and more recently in 1962, this feature has been tabbed as the NIH's strongest asset and the most attractive employment feature in the eyes of its best scientists.

Actions Taken to Satisfy the Needs for Creativity at the NIH

We have found that while it is neither possible nor desirable to duplicate in the Federal setting all of the advantages and traditions of university employment, it is possible to provide for activities which will ensure the establishment of those practices which are essential for individual professional development and achievement. Among other things, we have:

1. Special provisions for appointing young doctorates to two-year fellowships (internships in science) with authority for one year renewals and conversions to continuing civil service appointments in outstanding cases. These fellowships correspond with those awarded in the university settings and incorporate the ease of appointment, provision for extended tenure and honorific features of university fellowships. At the same time, there is no permanent commitment by either NIH or the fellow.

2. Provision for world-wide recruitment through multiple personnel systems geared to the needs of the situation.

3. Provision for transient visitors -- guest lecturers and guest workers -- who are regularly invited to visit and participate in the research activities of the NIH.

4. Provision for foreign travel, meeting attendance and participation in professional activities including attendance at meetings.

5. Provision for special training at universities and other centers of research. While we are unable to offer sabbaticals as such, the provisions of the Government Employee's Training Act does make it possible to detail worthy NIH scientists to academic institutes or other centers for research. In many respects, such details serve the purpose of a formal sabbatical.

6. Provision for a special graduate school to satisfy the expressed need of the scientists to engage in teaching activities (The Foundation for Advanced Education in the Sciences, Inc.)

7. Plans for frequent seminars, symposia and lectures through which members of the NIH professional staff share experiences and learn from one another.

8. An administrative system designed to free the scientist from day-to-day administrative details to the greatest possible extent.

Areas of Dissatisfaction in the NIH Working Environment

Clearly, the above measures have been quite effective in helping us maintain an environment which is intellectually stimulating to our better scientists. These provisions have helped to compensate for the widening disparity in Government and university salaries. On the other hand, we find that there are some areas which still need our attnetion. These elements in the work environment which serve as sources of irritants and dissatisfactions to our better scientists are:

1. Excessive administrative and regulatory requirements relating to time and leave, travel, job classification, etc. These promote

moral cheating; the basic assumption is that the scientist is dishonest until proven honest.

2. Completely unrealistic and unworkable restrictions in the area of outside work activities. The most important measure of a scientist's competence is the extent to which he is recognized by his outside peers. No other form of recognition is meaningful.

3. Unrealistic tenure system for many positions -- our better scientists want a minimum of 3-5 years for all positions.

4. Unrealistic job titles -- our scientists want more meaningful, honorific titles -- preferably of the academic type.

5. Need for a greater feeling of belonging to a professional community -- our scientists want to belong to a senior scientist association or to have access to a faculty club or the like.

6. Lack of entertainment funds and facilities -- our scientists serve as hosts to many visiting dignitaries and must fund these out of their own pockets and provide own facilities for entertaining.

7. Unrealistic Incentive Awards System -- many of our scientists feel strongly that the present awards system is out of place in a research setting -- excellence is everyone's goal.

9. Patent policy

Conclusion

In conclusion, it is clear to us that the best scientists seek an environment where the limitations on their research and closely related activities will be

mostly from within themselves and where the limitations imposed by the environment itself will be minimal. They seek an environment where the creative process will be vigorously encouraged, where they will have the greatest possible freedom in selecting the methods and scope of their work. They seek an environment where decisions with respect to research support (space, salaries, promotions, facilities) be based upon the highest possible professional standards and no others. In all issues relating to their work, both tangible and intangible, they insist that there be the highest possible standards applied. In the eyes of the best scientists, there can be no substitute for excellence.

We must maintain continuous surveillance of the practices of our competitors and we must continually strive to provide for the greatest possible flexibility. There will never be a final resolution to the problem of retaining and keeping the best scientists, we must always be prepared to change our policies and operations to make sure that our work environment is fully stimulating and meets all of the important needs of the scientists.

(1.) Pleasure to be here ÷

(2.) In selection of material I had decided to follow the material Dr. Dryden presented to a comparable group in September -
Modification to relate experience in life sciences at NIH
rather than Physical Sciences and engineering at NASA.

(3.) Had good fortune to see a transcript of The Brookings report — shortly to be released - That purports to define the popular image of the Civil Service employee -
Two things stand out
1- he is a rather dull and stodgy individual
2- he apparently has a discernable character not prominent in which is intellectual rigor -

4. I would take broad issue with the report if in fact its portrayal of the federal scientist is so described.

a - I don't believe there is such a stereotype

b - Nor do I believe there is a comparable one that describes the university scientists.

* There are good scientists and I am afraid bad scientists within the federal establishment. There are good scientists and bad scientists in the university.

* Also There are good university environments and there are mediocre ~~university~~ environments even as there are good and mediocre operations within the federal establishment.

One in regard of these situations is excellence generally related to size and complexity.

Generally speaking the degree of excellence reflects the attitude of top administration whether within the government or within the University world.

Even as it reflects our own attitudes towards predictability or the desirability of quality and excellence as a guide to our public and learning development

A major problem within government derives from the fact that contrary to the University world top management is generally without technical background and quite unable to discern the elements within an environment that lead to excellence and productivity but this is changing rapidly within our own government. Even as industrial leadership has long since found essential for ~~management decisions~~ scientists to have an important role at the management table so in government we are beginning to have substantial scientific and technical representation within our government at the policy level

I would say finally that this lecture of discussion
that we still have a long way to go and that that
is the process of development could go on here
learning and deep concern for our own
environments, strive for excellence in those
areas that we can make some contribution,
build up our own standard of excellence with
the reasonable expectation that this will lead
to broadening of excellence and quality due only
to the recognition that we all will for so deeply

Problems of training for today as opposed to
tomorrow - more difficult in the federal establishment
as in industry because of day to day pressures
& crises

Similarly maintenance of intellectual depth
& breadth possible only by positive effort on
person the scientist is so protected from
the academic environment

Striking difference between formal training
and continuing education -

TAB 29

DISCUSSION OF THE NATIONAL INSTITUTES OF HEALTH BEFORE THE WOOLDRIDGE COMMITTEE[1]

By James A. Shannon, M.D.[2]

The NIH Program in Relation to the Nation's Research and Development Effort

(Morning Session)

Medical research is entering a new and exciting era of discovery--a fact that strongly conditions our philosophy of support and leadership. On the one hand, this era is characterized by a significant ability to quantify many established phenomena. Ingenious physical and mathematical models can be devised which are capable of productive extensions of present knowledge. On the other hand, explorations of wholly new phenomena are yielding information critical to the understanding of major diseases. The new discoveries concern cellular and subcellular systems, such as those for transmitting genetic information, and complex, integrative systems, such as the communications network of the brain.

The program of the National Institutes of Health is having a profound effect on the rate and manner in which many fields of medical and health-related research develop and progress. Among the requirements

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1/Excerpt of morning and afternoon presentations, Washington, D.C., January 9, 1964.

2/Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

of an effective program in medical research today are that it provide comprehensive support--that resources essential to medical research, such as facilities and manpower, be sustained in addition to scientific projects. This implies intelligent obligation to the framework of graduate-level research and education, currently and for the future. It is in the light of these aspects of medical research that the NIH program may be most in need of consideration, since they involve public policy and have received increasing attention.

The main problem posed by the present conference is this: to portray in its essentials a complex and highly diversified operation concerned with scientific fields of exploration and application in the interest of human health--fields that are generally apart from the professional background of most of this committee's members. In order to do this in a meaningful way, we have chosen to present a series of vignettes that will neither be complete nor be addressed directly to the substantive details of the research and support activities. Rather we will attempt to describe these activities in terms of (1) their general nature, (2) factors that have affected their development, (3) problems confronting NIH as viewed by us and by others concerned with the effectiveness of our programs, and finally (4) the future opportunity for a national medical science effort.

The presentations--my own and those of my staff--will be informal and designed for interruption at any point for questioning. It is hoped, however, that the questioning may be confined to a generally informational level during the morning session and that the afternoon

may be devoted to broad issues of scientific and public policy. By way of introduction, I should like to spend the next 30 or 40 minutes dealing with the generalities of the NIH operation.

Organization and Functions*

First, a word about organizational setting. The National Institutes of Health, represented in the first chart (page 13), is one of three operating bureaus of the Public Health Service. Its general mission is to conduct, on an adequate national scale, research into serious disease, and to do this in a manner that yields information applicable to today's health problems. At the same time, it provides a meaningful structure for the advancement of sciences relevant to health as a means of approaching the problems of tomorrow.

The Public Health Service, in turn, is a constituent of the Department of Health, Education, and Welfare, shown in chart 2. The Department also contains, on an equal organizational footing, the Office of Education, the Social Security Administration, Food and Drug Administration, Vocational Rehabilitation Administration, Welfare Administration, and St. Elizabeths Hospital.

The Nature of Biomedical Investigation

The totality of medical and health-related research comprises roughly a 50-50 mix of fundamental and applied investigation, some of which may be clearly descriptive on the one hand and broadly explorative on the other. Frank developmental work is only beginning. Other characteristics of the current medical research scene are a predominance of individual

*Some of the following data are more current than those given in background materials submitted to the committee.

over group activity, an orientation more academic than industrial, and a high professional content.

We will not discuss the end objectives, or targets, of medical research, except to say that these have changed in general over recent decades. Outstanding were the eras in which research sought control of disease largely through knowledge of its transmission, then through chemotherapy (resulting in the sulfonamides and antibiotics), and currently through profound elucidation of the basic life processes as an approach to dealing with chronic degenerative conditions such as cancer and arteriosclerosis.

A beginning can be made by considering the nature of the paramount health problems that affect this nation today. Chart 3 represents life expectancy at the turn of the century and again in 1960, and shows that the average person's life span from birth increased by 43 percent whereas the increase from age 45 was only 16 percent. This reflects a greater decline in diseases that produce a high mortality in infancy and youth than in those of middle and old age. In medical research programs today, the emphasis on chronic, degenerative diseases represents an effort to reduce illness and premature death from causes having the greatest impact in human and economic terms. NIH is organized to study the major disease categories--heart disease, cancer, mental illness, and so forth--and has recently broadened its support in noncategorical fields.

Economics of the National Scene

Next I should like to move to a discussion of the dollar value of medical research as this has evolved during the past 12 or 13 years. Chart 4 represents medical research as a proportion of all research and

development. Medical research has grown from about $161 million in 1950 to $1.5 billion in 1963. Thus it has kept pace with the expansion of all R & D, ranging between 6 and 8 percent of the total since 1960. The bulk of R & D is devoted to national defense and space exploration. Here the term "research" does not include research training, construction, or other auxiliary activities.

Chart 5 shows the sources of medical research funds since 1940. Non-Federal sources of research funds exceeded Federal until the late 1950's. In 1964 Federal expenditures will be about $1,084 million as against non-Federal $591 million. The bulk of this research is conducted in schools and other nonprofit, non-Federal institutions. It is encouraging that private giving continues to rise despite the taxpayer's support of medical research through government, indicating that the public and private efforts are mutually stimulating. It should also be pointed out that diversity of sources is conducive to stability.

NIH in the Context of the Nation's Research

NIH funds are shown as a proportion of the Nation's medical research support in chart 6. In 1963 NIH research expenditures totaled about $570 million, or 39 percent of the Nation's health and health-related research support ($1.5 billion). Other Federal sources in 1963 were Defense $89 million, DHEW (other than NIH) $75, AEC $75, Space $34, VA $30, Agriculture $23, NSF $21, etc. Non-Federal support is from industry, private foundations, health agencies, other private sources, and State and local governments.

Chart 7 represents NIH program expansion--largely postwar--from

$3 million appropriated in 1945 to $968 million in 1964. The growth has been predominantly extramural--grants for research, training, and construction--and has resulted primarily from Acts of Congress which have tended to broaden program authority. Some significant landmarks:

1887--biological research initiated at Hygienic Lab.
1937--National Cancer Act.
1944--PHS Act, giving general research authority.
1945--research grants extended beyond cancer.
1950--new Institutes, rounding out program.
1953--Clinical Center opened to all Institutes.
1957--major program expansion.
1958--expansion of basic science support.
1962--expansion of general research and resources programs.
1963--new emphasis on child health and mental health.

The expansion of NIH programs has resulted in their meeting an increasing share of the cost of research in the Nation's educational institutions. Chart 8 represents the support of all scientific research in colleges and universities in 1952 and again in 1963, with the NIH share rising from less than a tenth to about a third. We are now the largest single contributor to scientific research in the schools. The second largest Federal contributor remains the Department of Defense, though this has been the slowest growing of the Federal programs. NSF has expanded from 1 percent to 12 percent of the total, and NASA, created in 1958, now represents 8 percent.

Today the distribution of NIH research grant support is about equal as between medical schools and all other types of institutions. As shown in chart 9, medical schools in 1952 received about 57 percent of NIH research grant funds, and the percentage after rising slightly declined about 10 points by 1960. Of course, support of medical schools has actually risen as total dollars expanded. The relative increase in the

support of nonmedical institutions reflects the growth of NIH basic science programs.

NIH functions, broadly defined, are twofold--the support and conduct of research against disease. In chart 10 the top three shaded areas represent NIH appropriations for grants and awards to non-Federal, nonprofit institutions. From 75 to 85 percent of NIH funds have been expended in this way in recent years. Then, about 6 percent of total funds are allocated for collaborative studies--research contracts and direct operations which together constitute the non-grant portion of programmed activity in cancer chemotherapy, perinatal research, etc. Roughly 7 percent is expended for the conduct of research, laboratory and clinical, at Bethesda headquarters and in the field. About half that amount goes for various other direct operations, such as disease control, biologics control and research, intramural training and program direction. Of the total 1964 appropriation ($968 million), about 28 percent has been allocated for the development of national resources--manpower and construction of research facilities.

Chart 11 shows NIH program components in further detail, based on obligated amounts for fiscal 1963. Note the diversity of operations in each group of functions.

Chart 12 represents NIH at three stages in its development--1930, 1948, 1963. It shows the shift from an orientation to scientific disciplines (noncategorical) to one based on disease categories as well as non-categorical groupings. In 1948--the year in which NIH became the National Institutes of Health--services to the several Institutes were mixed with program operations in the Division of Research Grants, but

are now clearly separated.

The next chart (13) represents 1964 appropriations to the nine Institutes. Each of the seven categorical Institutes conducts research and supports research and training, whereas General Medical Sciences and Child Health & Human Development at present conduct only supportive operations. Child Health, established in January 1963, has been activated by transfer of grants from other Institutes.

Chart 14 represents the programs of the operating Divisions--Biologics Standards and Research Facilities & Resources--and the Office of International Research. DBS is charged with research and regulatory functions in the field of biologic drugs, such as vaccines, antisera, blood, and blood products. It should be noted that OIR aids in the coordination of grants and awards made by all the Institutes to foreign scientists. In fiscal 1963, NIH made 1,685 international awards totaling $20.5 million. Construction grants ($50 million) are made under the Health Research Facilities Act and require matching funds. Charts 13 and 14 together represent programs totaling $968 million (as shown in chart 10).

Fiscal 1963 obligations for NIH grant and award programs are represented in chart 15, distributed as to their use in (1) development of a national base, (2) institutionally oriented support, and (3) mission-oriented support.

Chart 16 represents the expansion of NIH research grant programs in two dimensions--the increasing number of institutions, the increasing average amount per institution. In 1961 the number of institutions stood

at slightly over 1,200 and each received an average of $225,000. The corresponding figures for fiscal 1963 are approximately 1,659 and $270,000.

In chart 17 total national expenditures for medical research are plotted for the years 1947 through 1959, and three alternative projections are made to 1970. These are not set forth as a goal or target, but rather as reasonable approximations. The figure $3 billion, which calls for a trebling of the Nation's expenditures for medical and health-related research by 1970, has been utilized by NIH as a basis for estimating research manpower needs.* Estimated expenditures for 1962 and '63 have been added to the chart since the projections were made.

A View to the Future: Problems and Opportunities of NIH Programs

(Afternoon Session)

NIH programs will probably play a significant part in the future of medical research. They will have the capacity of influencing the course of the biomedical sciences, the functions of educational institutions, the careers of scientists, the process of medical education, the character of health services, and the well-being of man. The factors bearing upon the material, direction, and objectives of this developmental force are therefore considerations of great importance. In discussing these factors, we will attempt to structure our presentation in such a way that the judgment of this group can contribute to the perspective in which a broad national strategy for further development in this area might be formulated.

In the foreseeable future, the behavioral sciences will be increasingly

*These projections are discussed in Resources for Medical Research, Report No. 3, January 1963--Manpower Resources and Requirements for Medical and Health Related Research, 1965-1970--issued by the NIH Office of Program Planning.

prominent and productive. A great deal more will be learned about normal mental processes, forming a sounder backdrop for studies ranging from such conditions as mental retardation to intellectual excellence. The process of learning and the cognitive faculties will be fruitfully investigated.

We can also look optimistically to the sciences related to human development, especially to investigations of the reproductive and hereditary processes. We can expect dramatic advances against diseases of virus origin, which may be found to include some forms of cancer in man. Another promising field is research directed to the control of environmental poisons and other hazards. In all of these studies, the epidemiologic approach will find increasing application. And there will be an extension of physical and mathematical concepts and technology in biology and medicine.

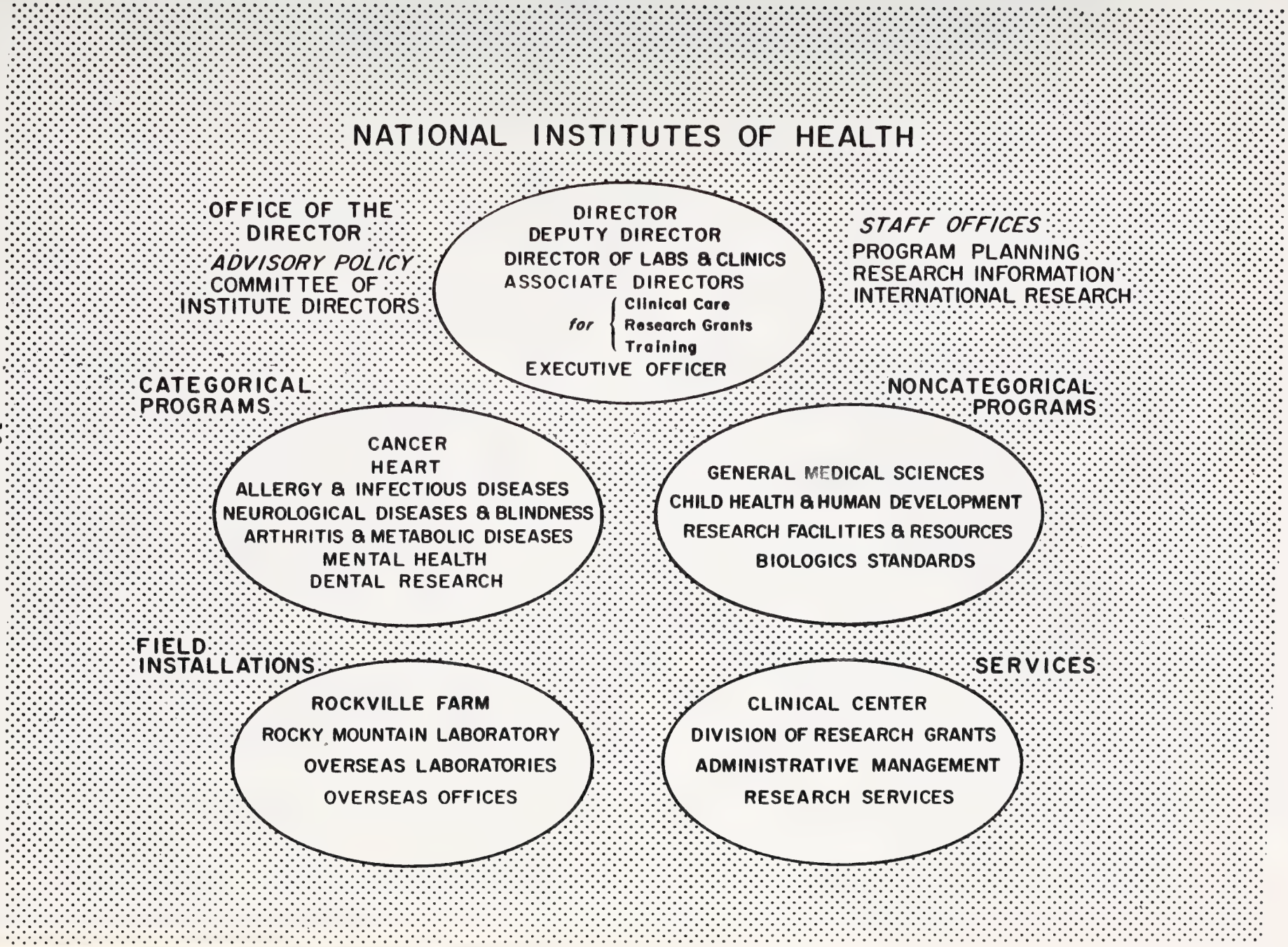
Among the administrative problems confronting medical research programs today is that of managing the scientific and technical information. The nature of the problem may be clarified by considering this information in terms of function: (1) administration, (2) exchange in the scientific community, (3) communication to the world of practice and health services. These information needs will require broad expansion of library functions, particularly with respect to secondary publications. We may also think in terms of the specialized information center as a possible approach. It is important, however, not to overestimate the magnitude of the problem, which is often called an "information explosion." Its rate of development is undoubtedly related to the expansion of scientific manpower. Today's approach calls for common sense; tomorrow's perhaps for Buck Rogers.

Balance among functions of a national research program is of course one of the primary considerations. In a program as far-reaching as that of NIH, an important objective is proper distribution of emphasis among support of research, manpower, facilities, and other resources. One of our major considerations is the character of future intramural development. We may reasonably inquire as to its raison d'etre, optimum size, and future directions. Another question for the future is that of the appropriate role of NIH in the development and testing of new drugs and other products. Still another question concerns the relationship of NIH to health service programs.

Balance among mechanisms of support might also be viewed with critical judgment. What are the strengths and limitations of the research project grant? How can the contract be most effectively employed? How and to what extent can general research support be best applied? What is the proper NIH role in career support? And how do training grants and fellowships compare as devices for expanding research manpower? The expansion of research capability in non-Federal institutions has been a major objective in NIH programs. Most of this effort has been addressed to the graduate level of training and to centers of research excellence, in keeping with NIH statutory missions against the major diseases. The broad view, however, compels attention to the undergraduate training level and the small institution. NIH has taken a positive stand toward development of research potential in those areas, but not to the extent of a major effort. It is also an objective of NIH to develop emerging fields of science. How actively should NIH pursue its objectives of

furthering the necessary expansion of national research potential and opening new areas of promise?

NIH is also involved in certain public policy issues of major importance. These are broad problems that may never be completely solved, but any serious consideration by responsible groups is helpful in program planning. One of the major issues concerns the development of a stable set of concepts and principles for the Federal-university-scientist relationship. A second issue is the creation and expansion of "centers of excellence." A third concerns the geographic distribution of research potential. A fourth is education--the Federal role in the broad expansion of the intellectual capability of the Nation. Attainment of a national consensus on these matters will be prolonged, and the nature of such action will obviously affect the course of national research programs.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RESEARCH INFORMATION
INTERNATIONAL RESEARCH
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CANCER
HEART
ALLERGY & INFECTIOUS DISEASES
NEUROLOGICAL DISEASES & BLINDNESS
ARTHRITIS & METABOLIC DISEASES
MENTAL HEALTH
DENTAL RESEARCH
NONCATEGORICAL PROGRAMS
GENERAL MEDICAL SCIENCES
CHILD HEALTH & HUMAN DEVELOPMENT
RESEARCH FACILITIES & RESOURCES
BIOLOGICS STANDARDS
FIELD INSTALLATIONS
ROCKVILLE FARM
ROCKY MOUNTAIN LABORATORY
OVERSEAS LABORATORIES
OVERSEAS OFFICES
SERVICES
CLINICAL CENTER
DIVISION OF RESEARCH GRANTS
ADMINISTRATIVE MANAGEMENT
RESEARCH SERVICES

Chart 2

U. S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE

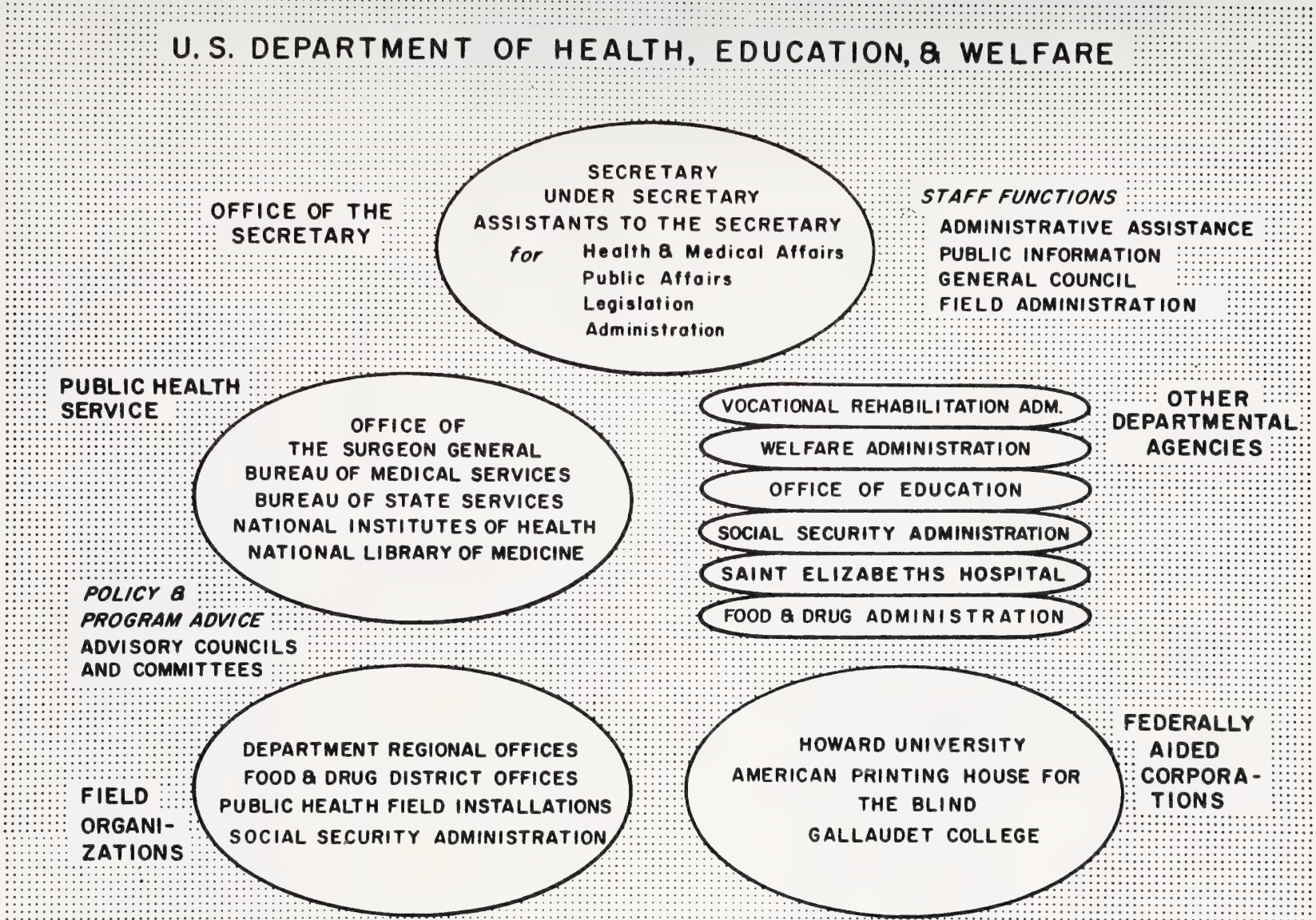


Chart 3

LIFE EXPECTANCY

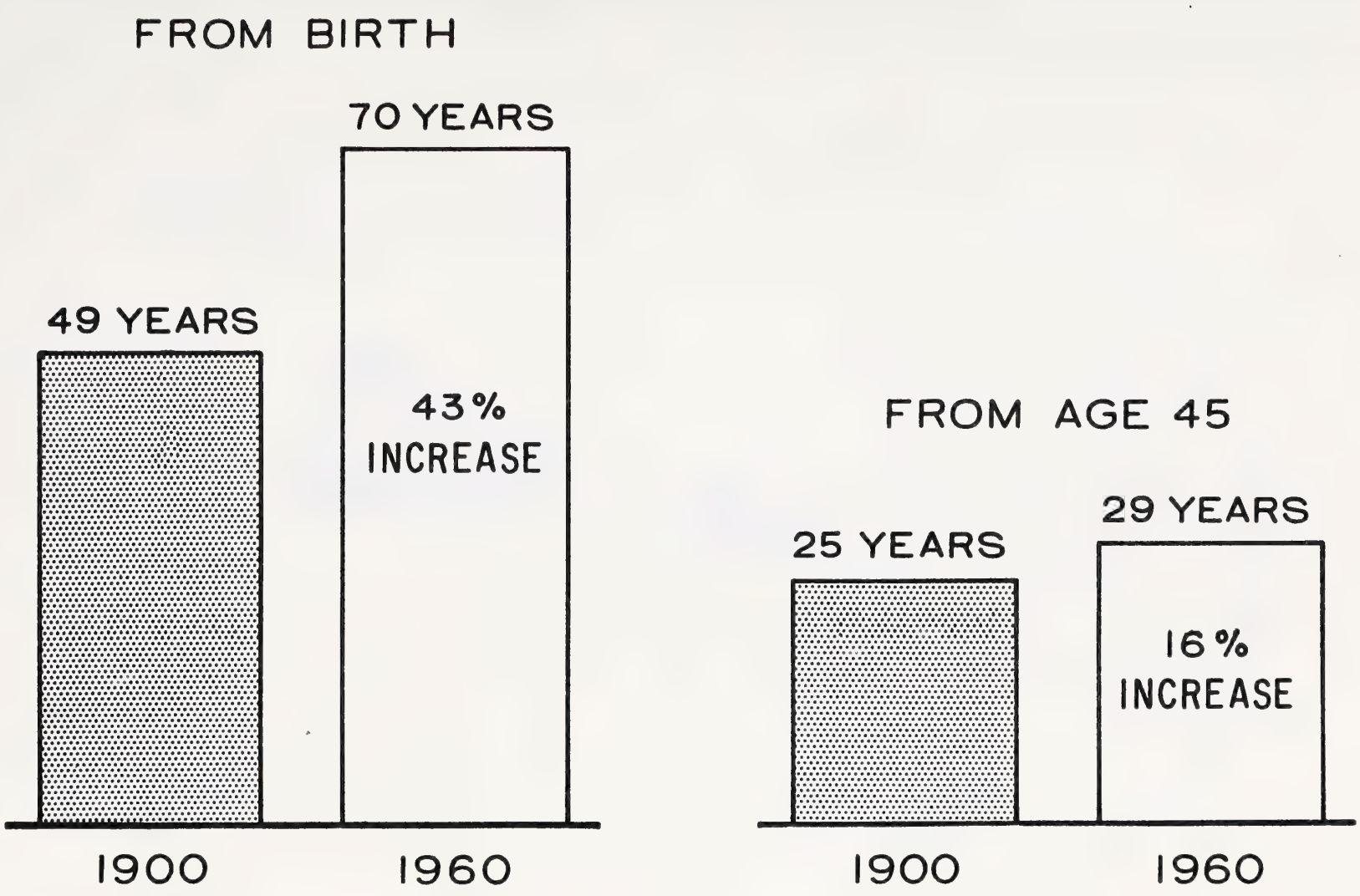


Chart 4

MEDICAL RESEARCH AS A PROPORTION OF ALL RESEARCH AND DEVELOPMENT

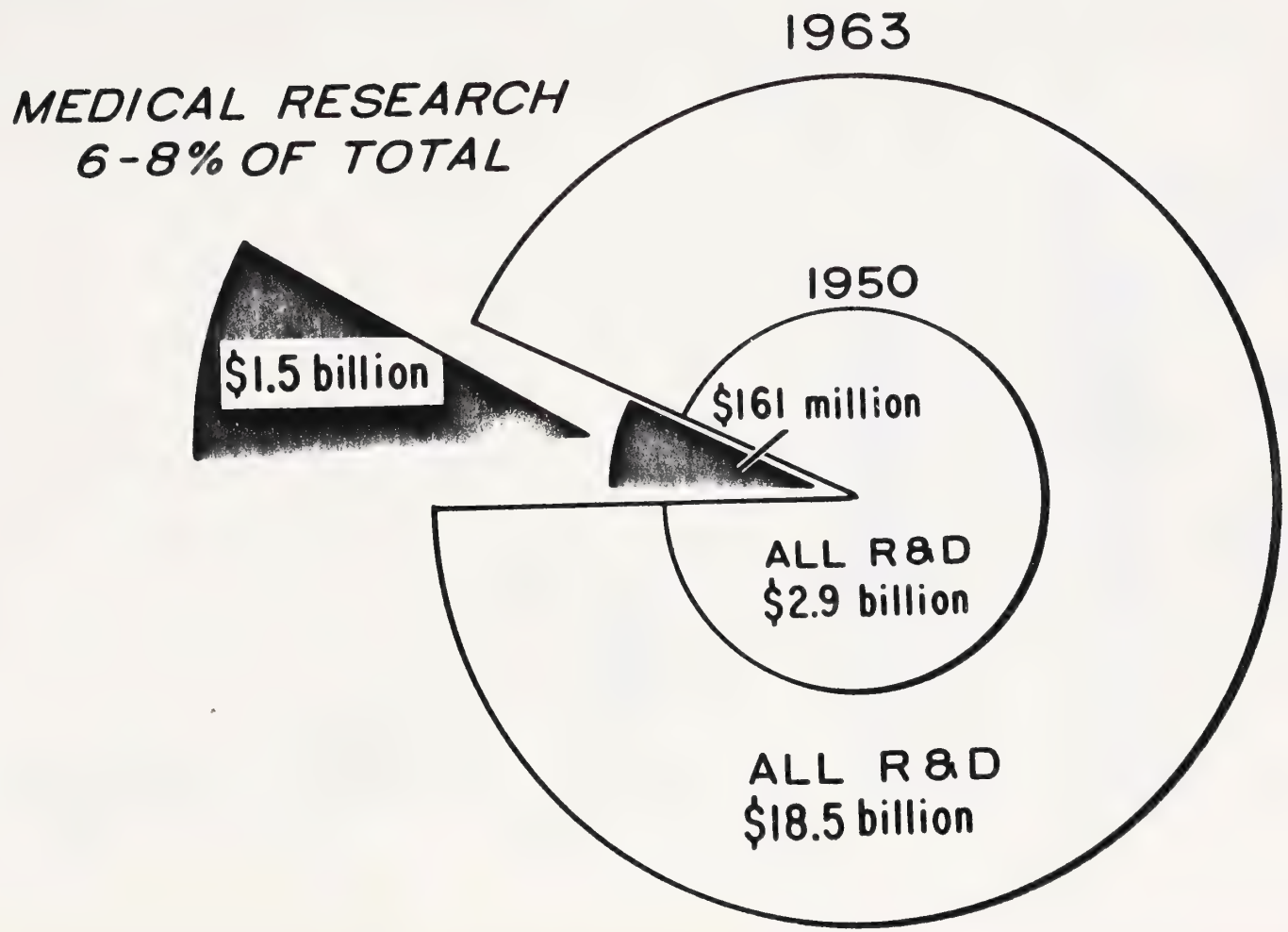
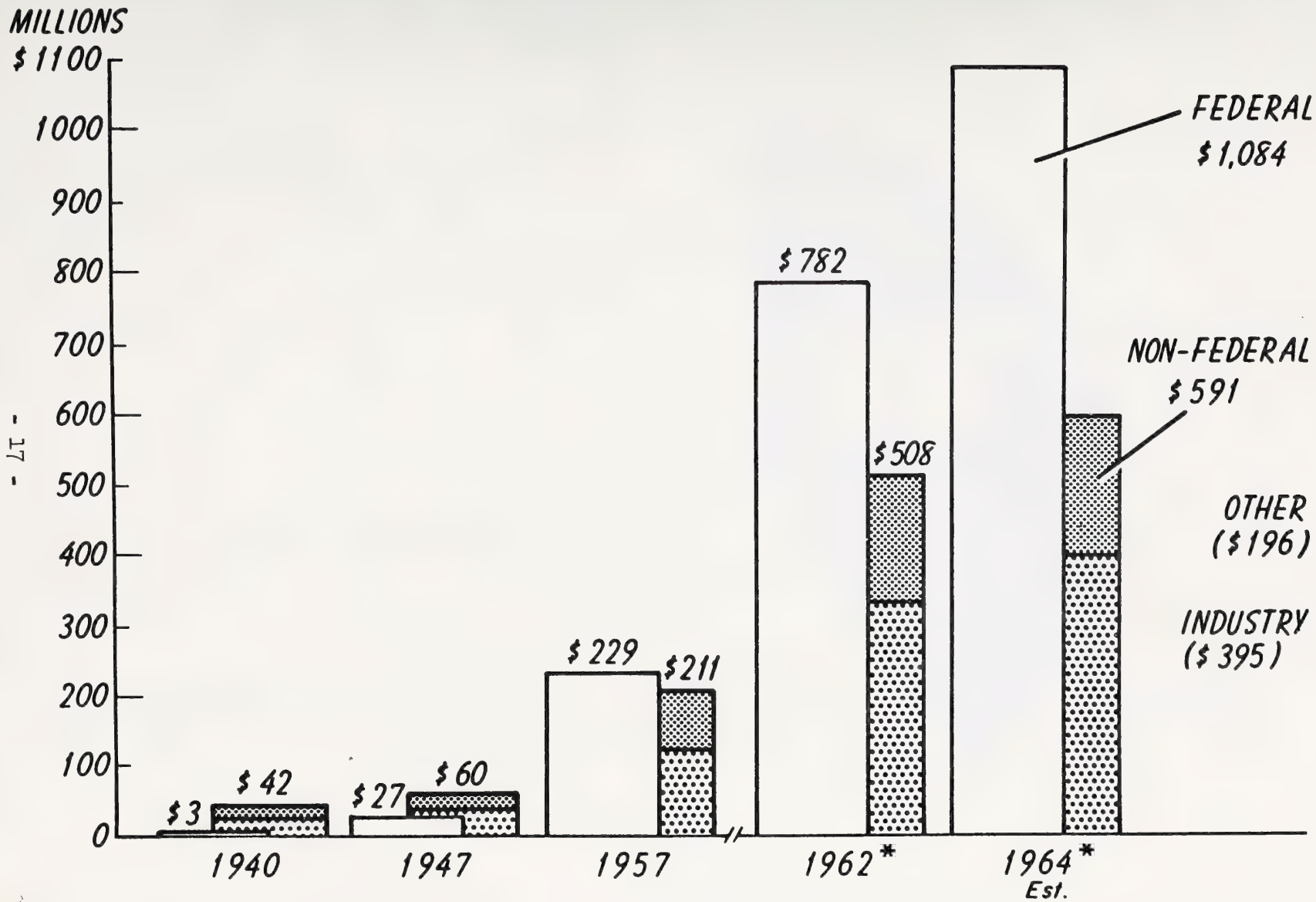


Chart 5

SOURCES OF MEDICAL RESEARCH FUNDS



*Non-Federal data not strictly comparable with those for prior years, since coverage has been improved.

Chart 6

NIH FUNDS AS A PROPORTION OF NATION'S MEDICAL RESEARCH SUPPORT

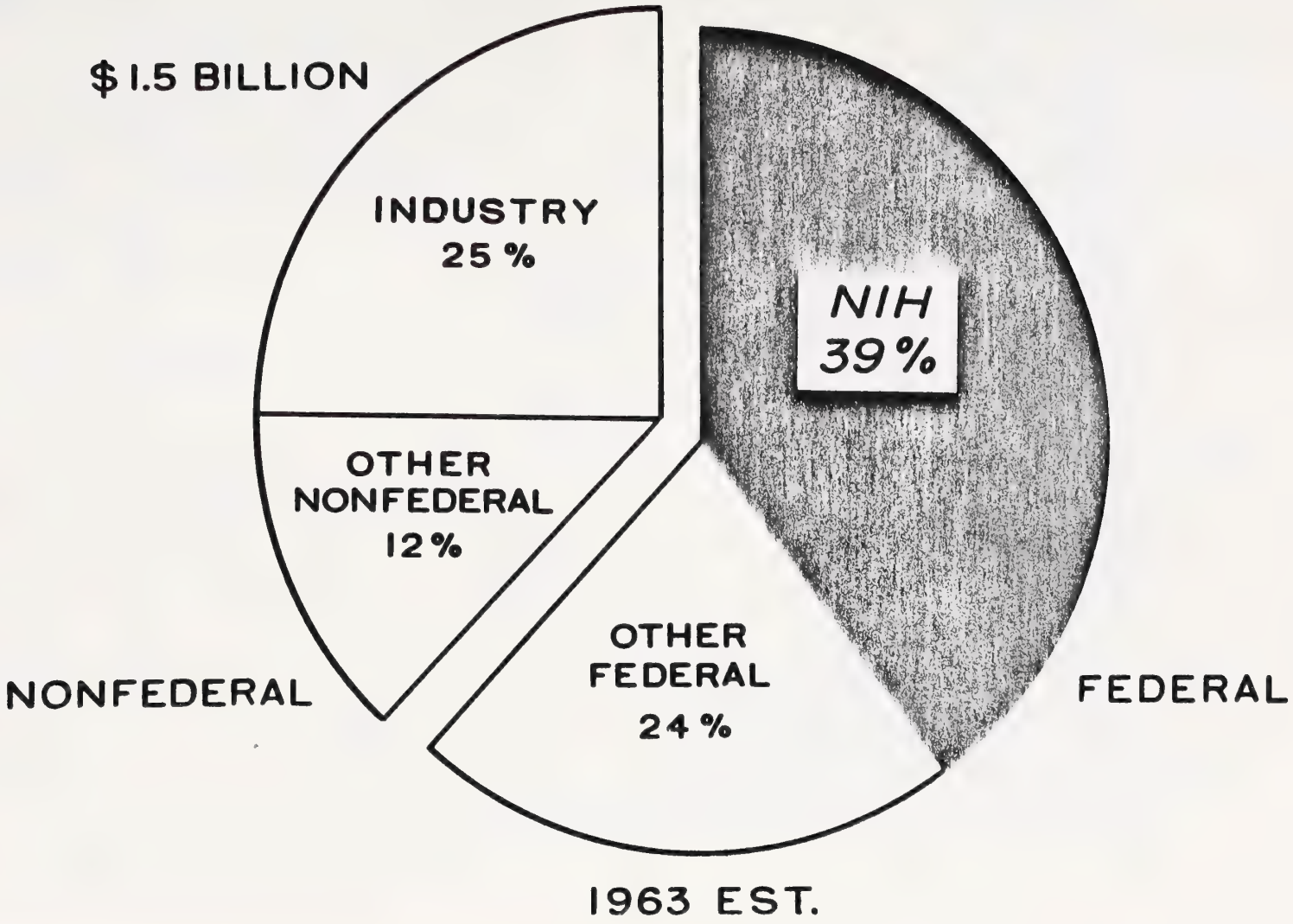


Chart 7

LEGISLATION AND OPERATING FUNDS

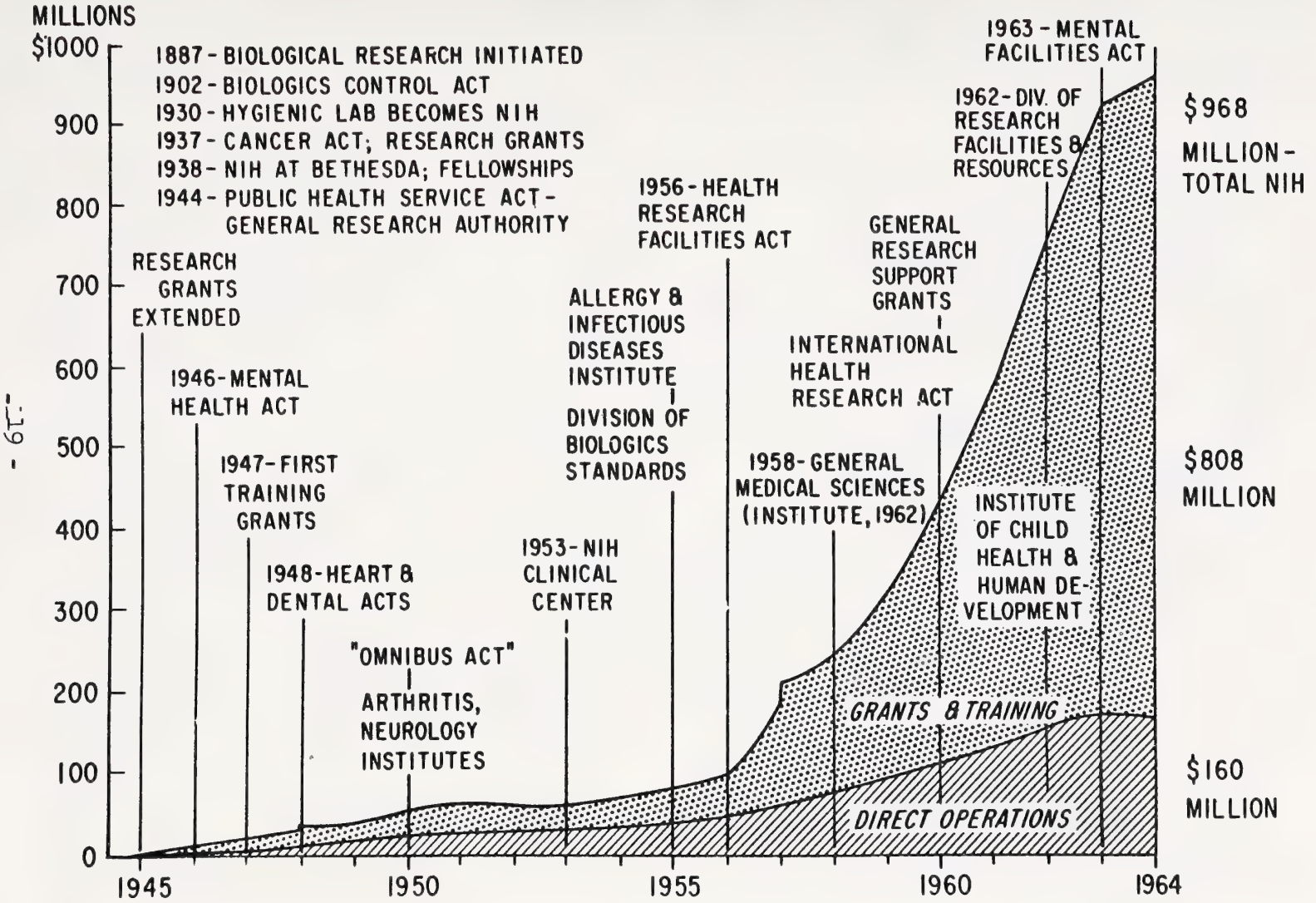
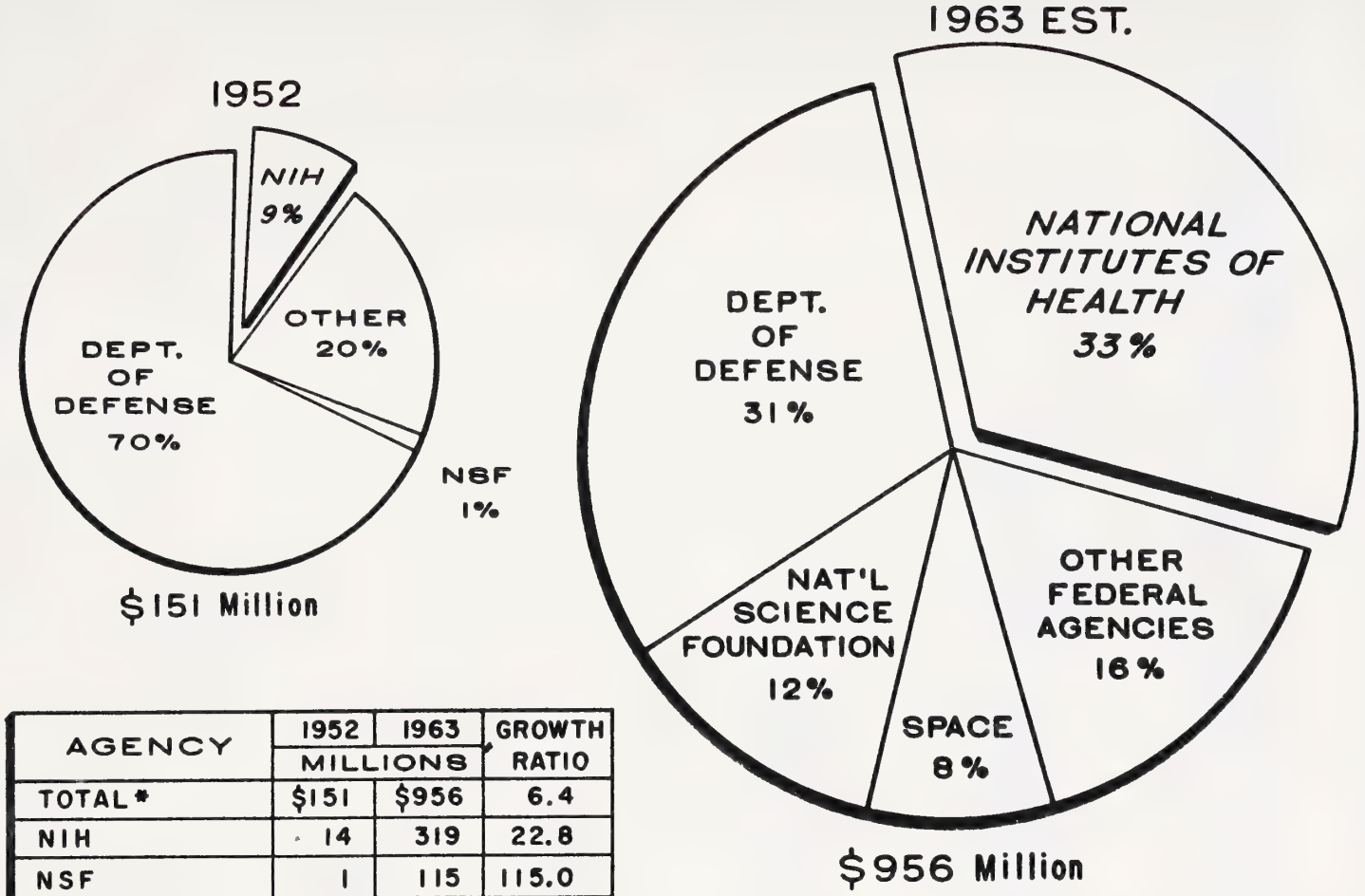


Chart 8

TRENDS IN FEDERAL SUPPORT OF RESEARCH AT COLLEGES AND UNIVERSITIES 1952 - 1963



AGENCY	1952	1963	GROWTH RATIO
	MILLIONS		
TOTAL*	$151	$956	6.4
NIH	14	319	22.8
NSF	1	115	115.0
Defense	106	296	2.8
Other Federal†	30	226	7.5

* Excludes university-managed Federal contract research centers, such as Los Alamos, Argonne, and Jet-Propulsion Laboratory.

† Includes National Aeronautics & Space Administration.

Chart 9

HALF OF NIH RESEARCH GRANT FUNDS GO TO MEDICAL SCHOOLS, HALF TO OTHER INSTITUTIONS

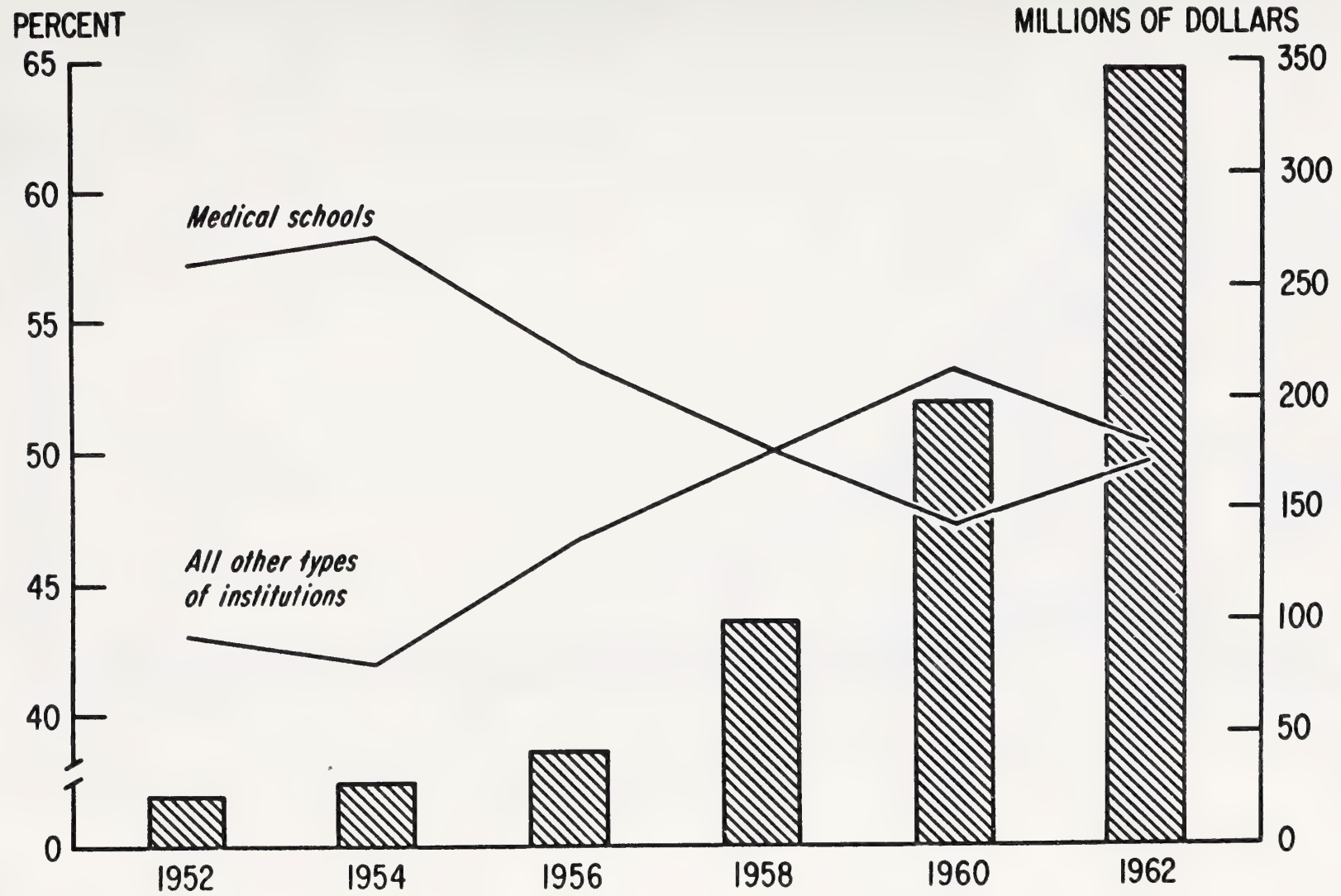
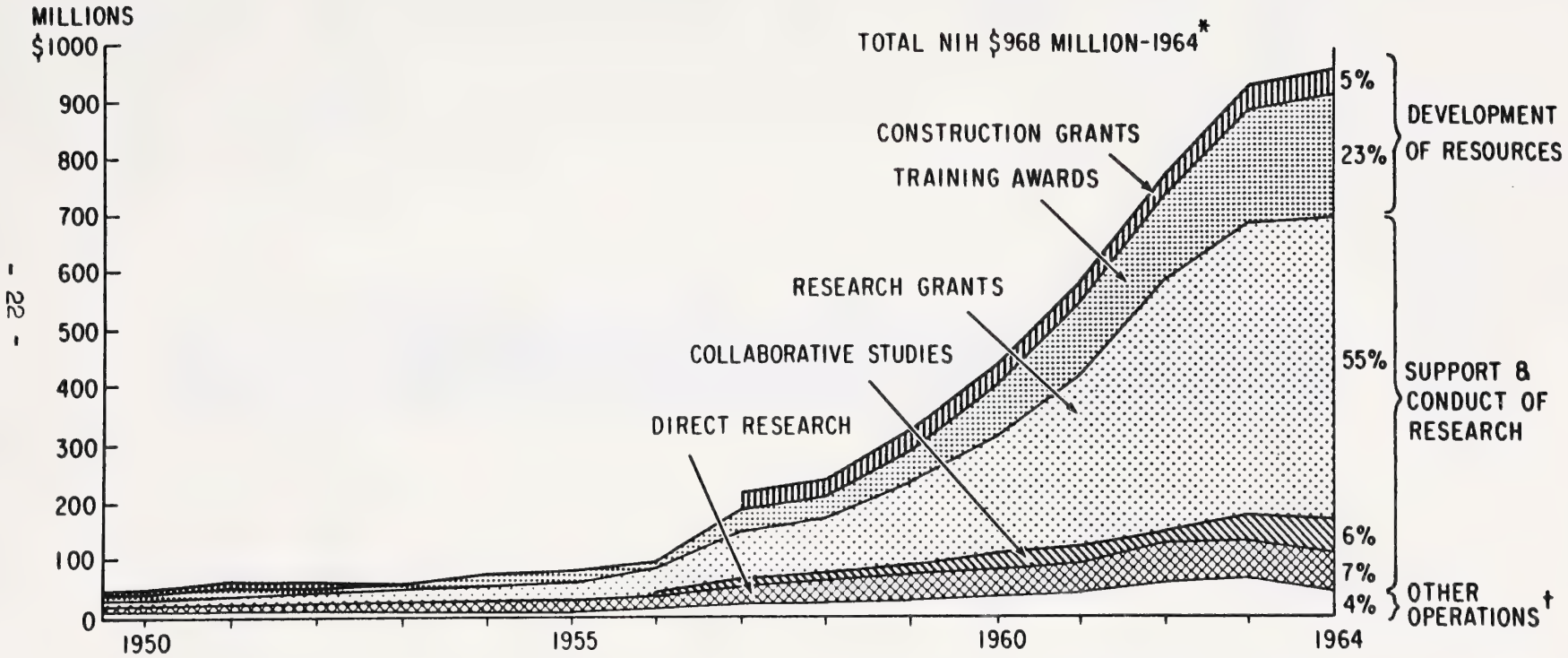


Chart 10

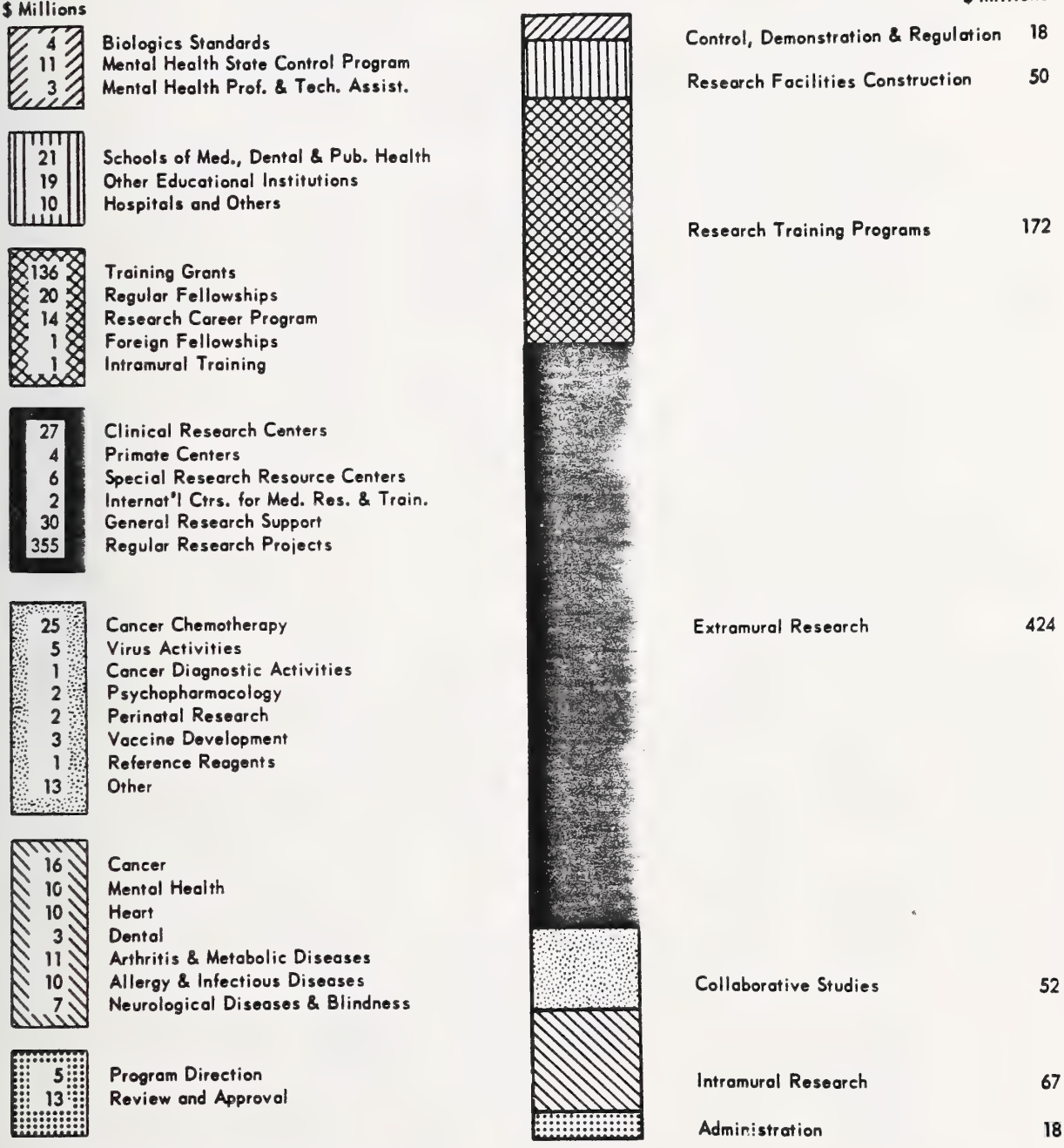
NIH – GROWTH AND FUNCTIONS



*Excludes direct construction – $0.5 million. †State control programs (Mental Health only in 1964), professional and technical assistance, training, program direction, review and approval, biologics control.

Chart 11

NIH FUNCTIONS AND PROGRAM COMPONENTS
(FY 1963 Obligations*)



*1963 Column of FY 1965 Estimate to B.O.B.

Chart 12

NIH—CHANGE IN ORGANIZATION

RESEARCH (NONCATEGORICAL, CATEGORICAL) AND SERVICES

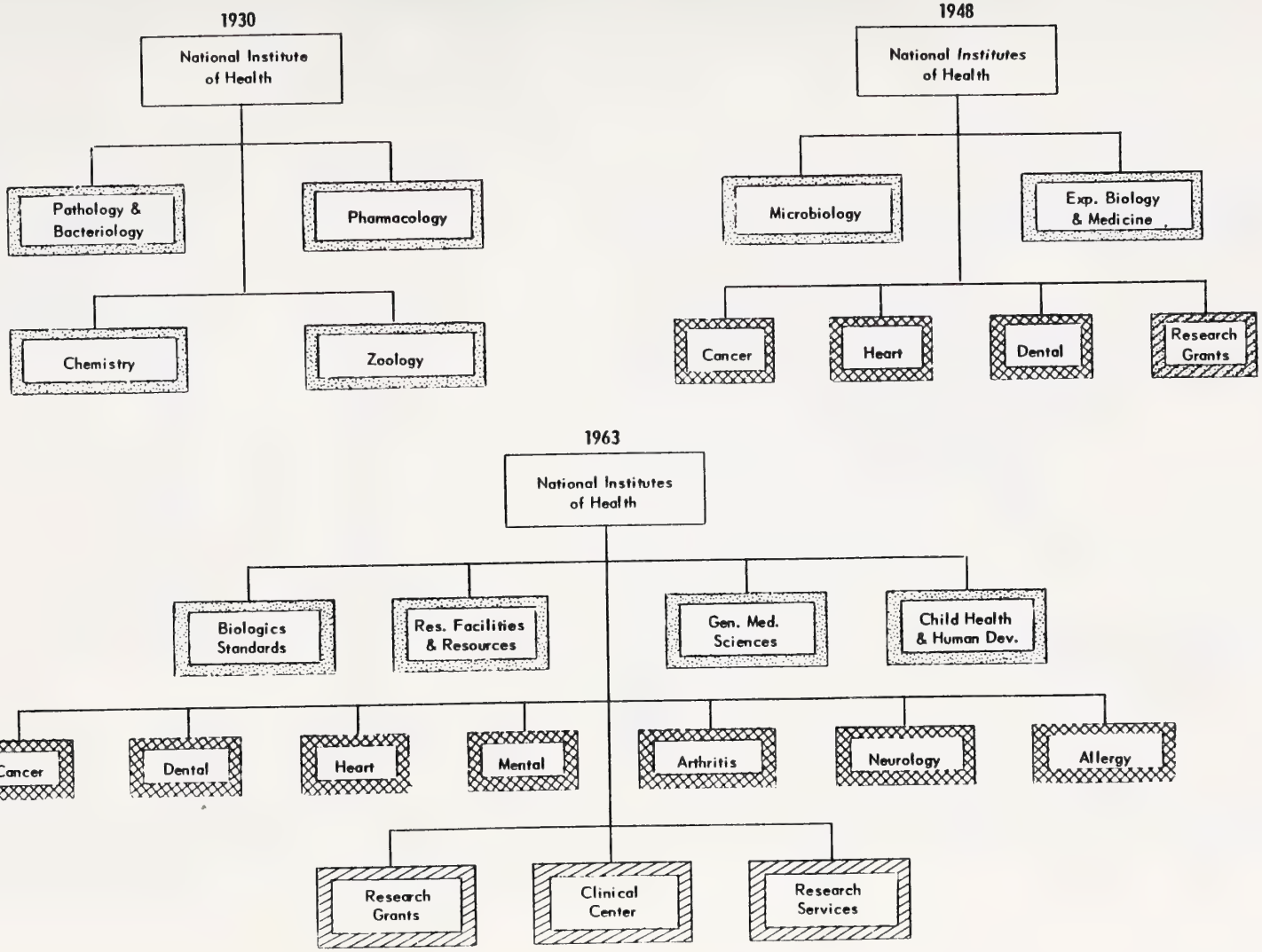
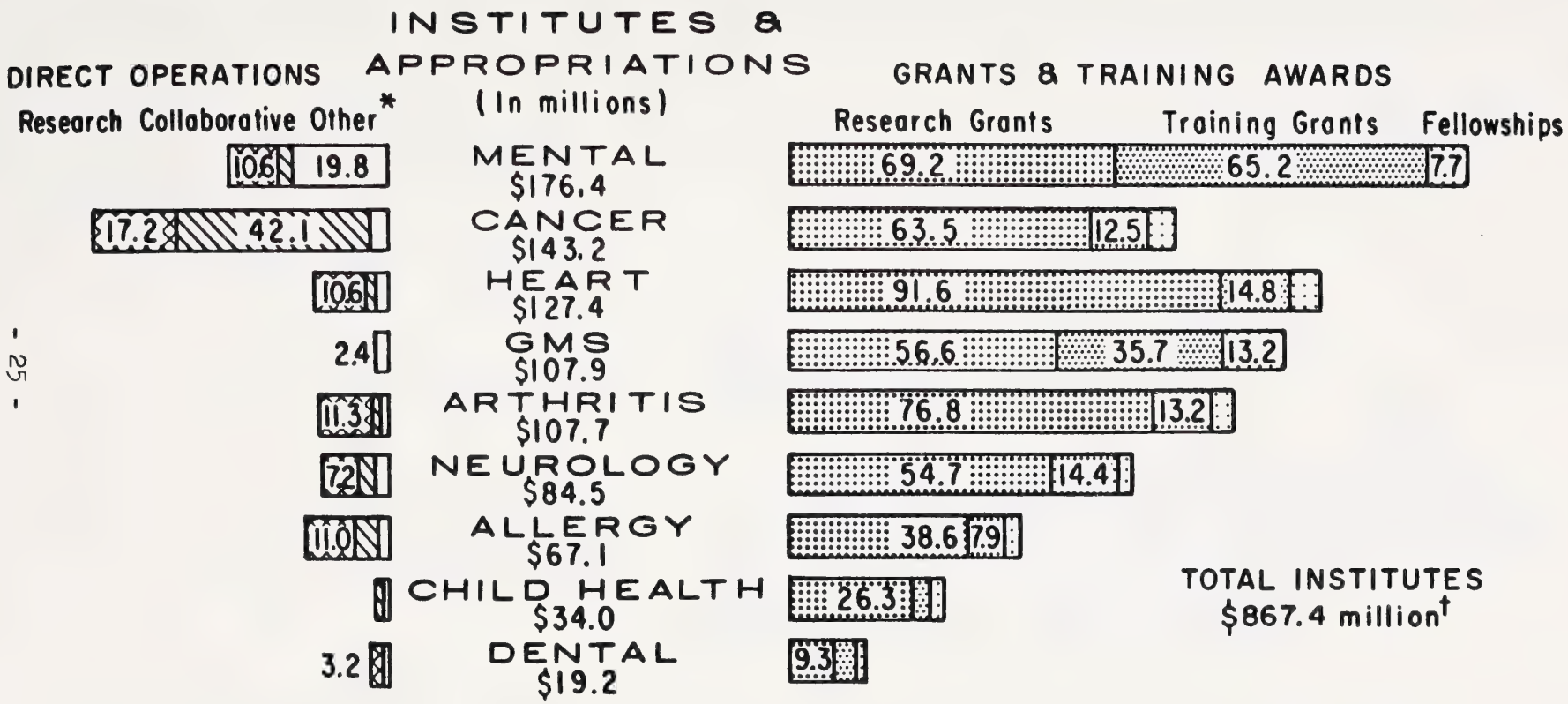


Chart 13

PROGRAMS OF THE 9 INSTITUTES, 1964

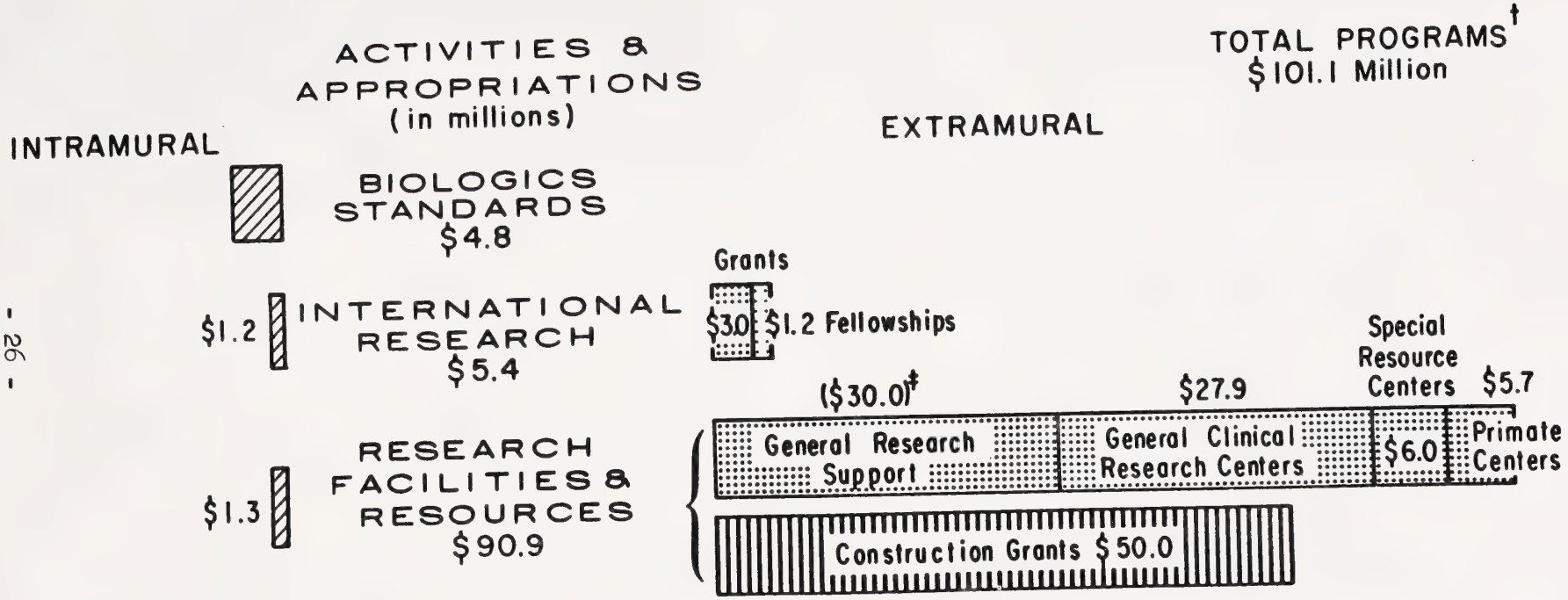


*Professional and technical assistance, state control programs, review and approval, training, administration.

†Does not include appropriated amounts for DBS $4.8, DRFR $40.9, OIR $5.4, Const. grants $50.0, direct construction $.5 (in millions).

Chart 14

PROGRAMS OF THE OPERATING DIVISIONS, 1964*



*Service and administrative activities – OD, OAM, DRS and DRG – are financed by reimbursement.
†Does not include $867 million appropriated to the 9 Institutes or $.5 for direct construction.
‡Transferred from Institutes.

Chart 15

NIH EXTRAMURAL PROGRAM ORIENTATION

1963 TOTAL* – $683 MILLION

$218 MILLION DEVELOPMENT OF NATIONAL BASE		$105 MILLION INSTITUTIONALLY ORIENTED SUPPORT		$360 MILLION MISSION-ORIENTED SUPPORT	
• Training Grants	$126†	• General Research & Training	$30	• Research Grants	$303†
• Facilities	50	• Career Development Program	14	• Chemotherapy Contracts	25
• Clinical Research Centers	27	• Indirect Costs	61	• Research Fellowships	21
• Resource Centers	15			• State Control Programs	11

*1963 Obligations

†Excludes Indirect Costs

Chart 16

NUMBER OF INSTITUTIONS RECEIVING NIH RESEARCH GRANTS AND AVERAGE AMOUNT PER INSTITUTION 1950-61

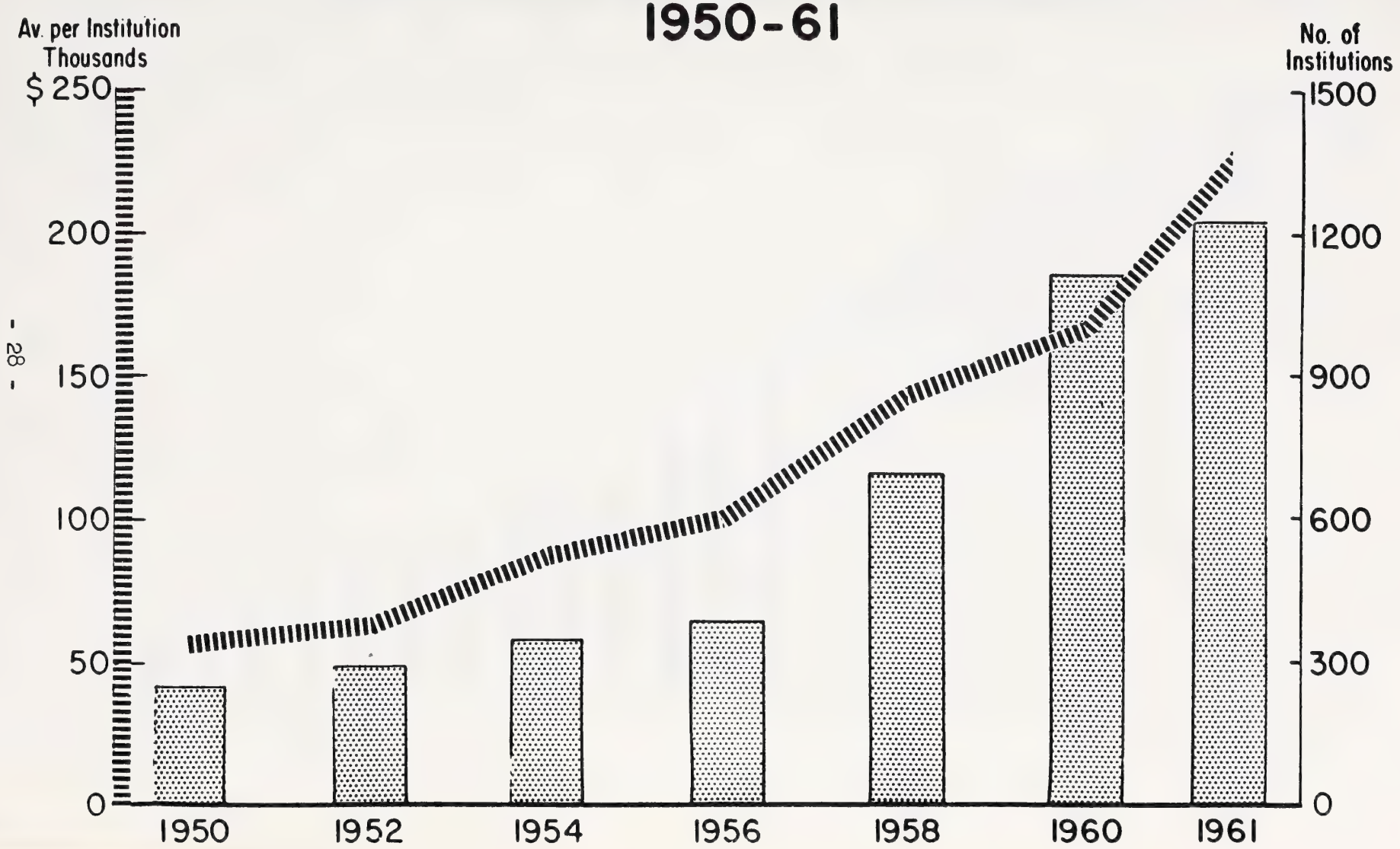
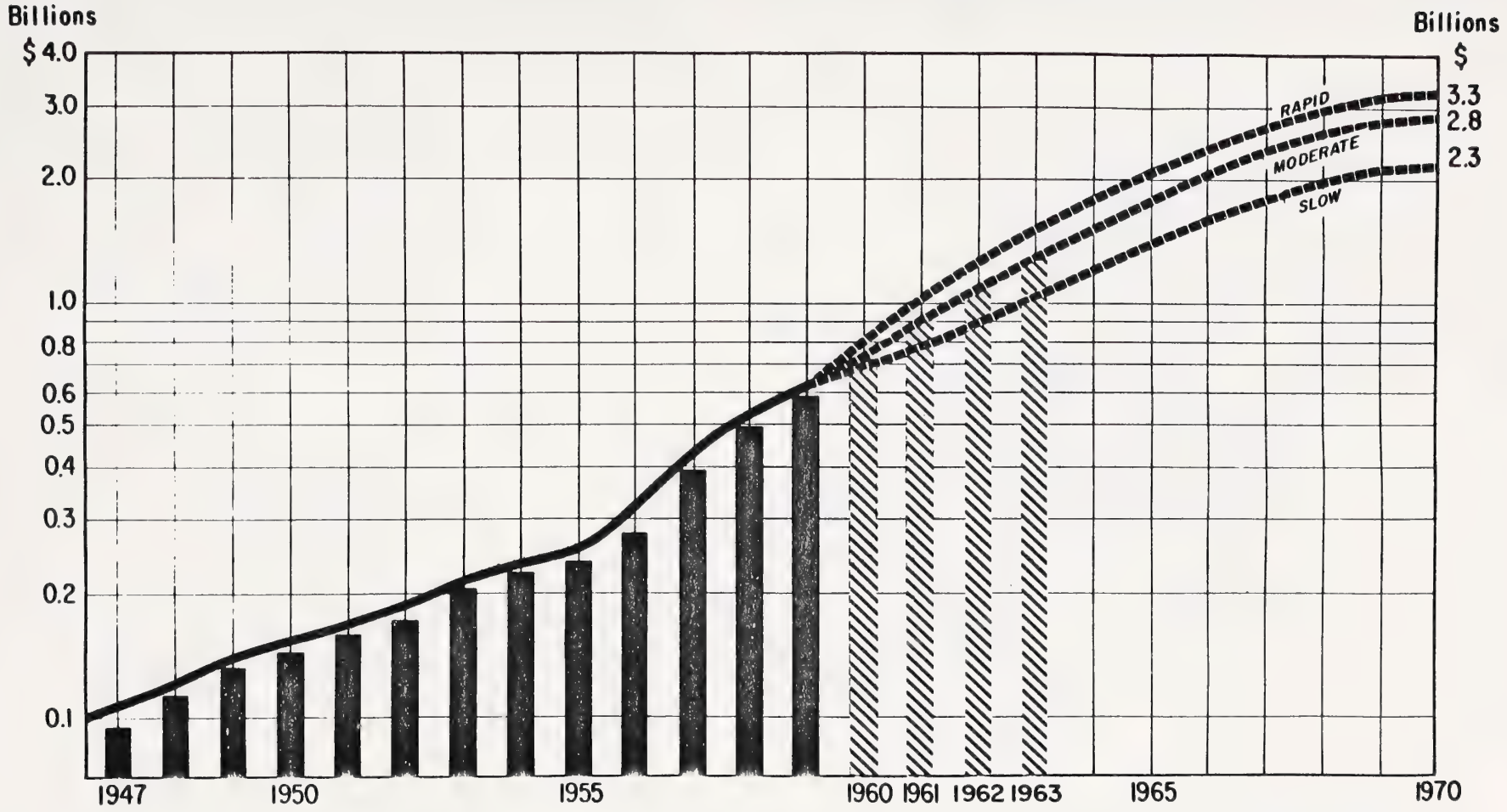


Chart 17

NATIONAL EXPENDITURES FOR MEDICAL RESEARCH, 1947-1959 AND ALTERNATIVE PROJECTIONS, 1960-1970



SOURCE: National Institutes of Health

RAS-OPP-NIH-12/61

TAB 30

Remarks of Dr. James A. Shannon
Director of the National Institutes of Health
On the occasion of receiving the degree of
Doctor of Medicine honoris causa
The University of Louvain, Belgium
February 2, 1954

Monsignor van Waeyenbergh,
Distinguished members of the University faculty,
My colleagues in medicine,
Ladies and Gentlemen:

I am indeed honored by the distinction conferred upon me here today. I esteem it a high privilege to be admitted to the illustrious alumni of the great University of Louvain and to be associated in this very special way with the distinguished members of the Faculty of Medicine.

From the time of my undergraduate days and my first awareness of tradition of the universities, the name of the University of Louvain has always held for me a particular significance as a world center of Catholic scholarship and intellectual activity; an institution that has played a major role in the development of the Christian civilization of the West. Thus to be so honored in your midst and amongst these environs is for me, to say the least, a very moving experience.

In pondering what I might usefully say in these brief remarks, I reflected upon the rise of the universities in the West and the profound influence they have had, and continue to have, upon the course of human affairs. I thought of the very unique status that the universities

occupy amongst human institutions. I thought I might draw from these reflections certain points which might have meaning in the circumstance in which we find ourselves today. Although I can say nothing new, I believe it appropriate to restate certain of the fundamental considerations concerning the role, function and significance of universities because in the contemporary scene these considerations are assuming a new significance and import.

In a very real sense the universities of today are the direct descendents of the medieval universities. The traditions of present-day universities, their organization, their role and functions, and their status in our society reflect a continuity which reaches back unbroken to the emergence of the university concept in the 12th and 13th centuries. This great University of Louvain is a notable exemplification of this splendid and cherished tradition.

It is not, however, the historical and antiquarian aspects of this tradition that are important and meaningful to us today. It is the basic and continuing values upon which this tradition rests. These values apply today as well as they did in the past, if not more so.

It has been said that "the glory of the medieval university was the consecration of learning" which they represented. In their dedication to intellectual activity, however circumscribed by the state of man's knowledge at any given time, the universities then and now embody the very essence and spirit of man's quest for knowledge of his origins, his nature, his destiny, and that of the universe in which

he exists. The universities thus are the very special institution that houses the [illegible], the teacher and the student bound in a common concern with the advancement and transmission of knowledge. In this role the universities provide a service to society of great and special importance. Thus the universities were set apart, given certain privileges essential to their role and function without which their particular service to society could not be fulfilled. Among these privileges is the strongly defended freedom to manage their academic affairs, "to decide for themselves who may teach, what will be taught, how it will be taught, and who may be taught." It is these academic freedoms that constitute the essential conditions for scholarly activity.

In forming a community within which such freedoms are protected the universities have served as a bastion against the strife and distraction of man's secular struggles, a refuge and sanctuary for the scholar and a germinal setting for creative "avant garde" intellectual activity. The fruits of this unique role have enormously extended man's scope of understanding, his capability of action, and his apprehension of the good, the true and the beautiful.

Through the strife of centuries these values and the traditions that preserve them have been sustained in the concept of the university as a community of scholars joined in the common pursuit and defense of intellectual endeavor. The definitive testament of the fundamental verity of this tradition is that this modern world, with all its innovation and diversity has devised no better alternative or superior substitute.

There is, however, a series of dangers to this great tradition in the modern scene. With the rise of science and technology now more than ever before, the shape of society, the vigor of nations and the well-being of man rests upon the intellectual endeavors of scholars, scientists and our institutions of higher learning. As a consequence the universities are called upon to play an ever-increasing role in the advancement of public purposes and thus are increasingly subjected to the interplay and demands of public aspirations. The inevitable accompaniment of these circumstances is the grave hazard of disturbing involvement in the controversies, strife and divisions of the community and the resultant peril to the essential values of the university concept.

I believe these dangers must be a matter of concern for all universities throughout the world but particularly so in those countries where sharp divisions of a political, cultural or racial nature exist. Circumstances which, unfortunately, the United States and Belgium seem to share.

I feel it important, therefore, to reemphasize an admonition that has been made many times. However much the universities are a part of the world and society in which they exist, they must vigorously protect their privileged status and the great tradition of freedom for intellectual endeavor against the inroads of the divisive forces of community strife.

This must be so, not because of any sentimental attachment to a great tradition, but because the very dignity of man and his quest for

truth rests upon these all too fragile and delicate values. In turn, the vigor of nations and the advance of civilization derive therefrom.

It has been said "that a nation which deprives universities of their freedom and independence, however directly or indirectly, must suffer inevitable intellectual and cultural decay. A university which is content to let its values and privileges be subordinated to the divisions of the community betrays not only itself but its country."

I believe we who have been honored here today by this great university, within the very walls where the great traditions of the academic concept were forged and so nobly defended on many dark occasions, must feel anew the urgent duty to rededicate ourselves to the enduring concept of the university and the protection of its high role and function amongst the institutions of man.

Dr. van Waeyenbergh..... Esteemed Rector Magnificus.... on behalf of Professor Moruzzi and myself, I thank you and the Faculty of Medicine for the great honor you have bestowed upon us today. I wish your splendid University many more centuries of courageous effort in service of man's temporal and spiritual aspirations.

TAB 31

Nation's Business

March 1964 Vol. 52 No. 3
Published by the Chamber of Commerce of the United States
Washington, D.C.

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How much prosperity by election time; where employment is headed next; what other taxes may be cut—and how soon

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Study of company practices provides pointers for finding, keeping competent personnel; latest on campus talent hunt

23 WASHINGTON MOOD: Economy drive makes impact
Reactions range from ecstatic to cynical but one thing is sure: President Johnson's savings push jolts the Capital

27 STATE OF THE NATION: What winner faces
More is at stake in this year's presidential election than ever before; here's how you can judge a candidate's fitness

31 OUTLOOK FOR THE BOOM: RISES AND RISKS

32 What's needed after tax cuts
Future of major national problem areas is analyzed; what government could do next to aid further economic advance

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U. S. loss of gold, dollars will apply economic pressures on future of your company; outlook offers some solutions

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An industrial specialist looks at unemployment problems and tells effects the nation can expect from proposed cures

38 How companies build on success
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They explain how loose lending policies could stunt growth of tomorrow's economy, aggravate any business downturn

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This pioneer in opinion and market research says business can do a much better job of pinpointing prospective buyers

80 Find your company's hidden strength
Consultant Peter Drucker suggests a look at your business from different vantage point may lead to marketing success

104 You'll live longer
New and dramatic gains in the fight against heart disease and cancer are predicted by authority on medical research

118 What are the facts?
Here are some facts you will find useful to answer claims that automation and technological changes eliminate jobs

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YOU'LL LIVE LONGER

Leading research authority tells where big gains in medicine will come in next five to 10 years and offers an appraisal of the health of businessmen

A NATION'S BUSINESS interview with **Dr. James A. Shannon**, Director, National Institutes of Health

MEDICAL SCIENCE WILL WIN important new victories in its fight against illness and death in the next five to 10 years.

As a result, Americans now alive can look forward to lengthening life expectancies.

That's the opinion of Dr. James A. Shannon, director of the National Institutes of Health, the Public Health Service's complex of medical research facilities headquartered at Bethesda, a Maryland suburb of the nation's capital.

Interviewed by NATION'S BUSINESS, Dr. Shannon says impressive gains in the struggle against heart and cancer diseases, our biggest killers, will come in the next five to ten years. He also foresees dramatic progress in the battle against other lethal and disabling illnesses. Some of the progress, he says, will be achieved through the wider and more ingenious use of artificial organs and new drugs.

What lies behind this confident size-up of the nation's health prospects?

Much of his optimism, Dr. Shannon explains, is based on massive research efforts already under way or in the planning stage at NIH and in other medical research centers. The program which he directs accounts, in itself, through direct operations, grants and contracts for more than 40 per cent of America's current annual medical research expenditures of $1.7 billion.

A tall, 59-year-old native of Hollis, N. Y., Dr. Shannon has headed NIH since 1955. In this post, and as assistant surgeon general of the Public Health Service, he carries a special responsibility for drawing broad national research policies and coordinating Public Health Service research activities.

Dr. Shannon is widely recognized in scientific circles for his original research in kidney function, and chemotherapy of malaria. He has spent most of his career in research and teaching, but for a time he held an executive post with E. R. Squibb & Son, a pharmaceutical firm—experience which gave him an opportunity to observe close up the health risks of businessmen. He discusses this subject, and others, in the interview which follows.

Dr. Shannon, how much progress against the big killer diseases can we expect in five or 10 years?

Well, at the top of the list you have heart and blood vessel diseases. These kill one out of two Americans.

Next comes cancer.

And mental illness is the biggest disabler. These constitute three very large chunks of our medical problems today.

Now, in cardiovascular disease I think one can expect we'll have a definite understanding of the cause of atherosclerosis (hardening of the arteries) and of hypertension (high blood pressure). Whether we'll also have sufficient information to prevent the progress of the disease, I don't know.

But there is enough basic information now to lead to the expectation that one could modify the course of atherosclerosis and its ability to kill, particularly through strokes or heart attacks.

The broad underpinning of atherosclerosis appears to be modified by some hormones. The question is whether you take chances on feminizing side-effects from hormones or take chances on the heart attacks. These hormones give you an opening wedge, a line of approach for better understanding the

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PHOTO ROBERT PHILLIPS

disease. It is quite likely that other remedies will come along that will retard the process without at the same time producing any undesirable side-effects.

Are we near any substantial advance against cancer?

Yes, there are promising areas. We're beginning to get a truly basic understanding of the relationship of virus infection of cells to development of tumors. Out of such an understanding can come vaccines and a better understanding of the disease so chemicals can be designed more effectively to curtail various cancerous growths. Chemicals are beginning to emerge that will be useful in destroying or, at the very least, retarding cancer.

One agent is methol trexate used against a particular cancer of the uterus. This is the first seriously malignant tumor that has been found to be wholly curable in a substantial proportion of patients with a chemical. Other chemicals have shown themselves effective in retarding leukemias—things of that sort.

So I think in the cancer field you can look for quite striking advances.

The problem is whether those advances will radically modify the general risk to the cancer patient, primarily because the advances probably will come bit by bit in specific types of cancer.

We have multiple cancers, just as we have multiple diseases caused by viruses and by bacteria. What may be highly effective in one may be ineffective in another.

Do you anticipate that in five to 10 years we will have a generally curative cancer vaccine?

No, I don't think so. I don't think there ever will be a cure-all cancer vaccine. In five or 10 years there will be a number of types of cancer that can be dealt with either in conjunction with vaccine or modified or cured with a chemical.

Could you identify some specific cancers which you feel may be conquerable in five or 10 years?

The leukemias have been selected by our people at NIH as most suitable for study. Leukemia can be studied in a highly quantitative fashion. The disease reproduces itself fairly uniformly, so that there is no marked variation from patient to patient. The assessment of a remedy, the assessment of what net change or what net benefit one has achieved is easier to determine here than in other forms of cancer.

Are there other areas of research where you expect promising results?

Yes. I think cell biology is one of the most exciting and active areas of current inquiry.

Some really important new things have been learned about the human cell in recent years.

Some day, building on this growing knowledge, we may be able to curb inheritable diseases and defects.

Couples planning marriage, for example, through a pre-marriage check-up, will know reasonably well the genetic risks in their marriage.

It may be possible to reduce or actually eliminate the hazard of couples producing children who are deformed or diseased.

This is still far off, but is a very reasonable expectation.

Will the big killer diseases in the United States in the future be substantially different from those we know now?

I think they will be the same. But I think the age of their appearance, hopefully, will be different.

Let's take heart disease. You have to die of something. Put it that way. And it's likely that the more things you prevent, the more people will die of heart disease.

Now, this is not because heart disease itself is not better understood and better handled. But what you expect in the advances in cardiovascular disease is to curtail the heart attacks in the thirties and forties, the early high blood pressures that are killing in their effect.

But if you stop them in the thirties and the forties and the fifties, as I say, you have to die of something, and it seems most likely to me that the cardiovascular system will still be 10 or 20 years from now the biggest immediate cause of death. But it will be death in older age groups than now.

So we can look forward to people living longer?

This is right.

Now, from the standpoint of cancer experiments, I can foresee a great reduction in deaths from cancer in a 10 to 20 year period.

As we get a broader understanding of precisely what contributes to cancer, then the way to use that information effectively is to cut off the causes at their origin rather than do anything to the individual, so that you reduce the hazards to the individual.

If the present research approach on viruses is as successful as we hope, we may in this time have some preventive means that will begin to affect life expectancy.

Businessmen and others who carry responsibility seen to work at a rather tense pace, drive themselves hard. Do you feel that the businessman faces particular health hazards?

First, I would say that I don't think the businessman works any harder now than he did 10 or 20 years ago. I think the successful businessman always worked hard and drove himself pretty much to his capability.

I say that having worked in industry for three years. The experience gave me a great deal of respect for the ability of the American businessman to set serious tasks for himself and go out and do them.

I was with Squibb Institute for Medical Research. But the point is that I also was on the board of directors of E. R. Squibb & Son, and I was on the executive management committee of the corporation, so that I had to solve problems other than just those in the laboratory. I had to concern myself with the affairs of the corporation. In other words, I had to participate in the meeting of a payroll.

Businessmen frequently like to say to a scientist, "Hell, you never had to meet a payroll. You don't know the pressures we're under." This type of thing. Well, I have seen that pressure.

In point of fact I think that American businessmen in general, the sensible ones, take care of themselves pretty well. They work hard, and they play hard, but by and large they also provide themselves with reasonable relaxation.

Take the typical successful businessman in New York. He generally will have a summer place outside, and generally he will take a pretty good vacation, and generally he will take a few weeks off in the wintertime. And in general he'll keep himself in pretty good condition.

Do you recommend a particular health routine for businessmen?

No. I would say that he needs no special rules. The only general rules, as far as I can see, are to eat a well rounded diet, get enough sleep and don't put on weight.

And get relaxation?

And get relaxation. But I think our business people do remarkably well.

Do you feel that the doctor-patient relationship has deteriorated in the United States?

I think beyond any doubt that the image of the physician in the mind of the average person has deteriorated in the past 20 years.

Why? Because doctors don't make house calls as much as they used to?

I think it may be something much more subtle than that.

Twenty or 30 years ago a physician didn't really have much he could offer a patient. Very few drugs. He had aspirin or morphine or codeine for pain. He had digitalis for a failing heart. He had insulin for diabetes. He had a series of fully standardized hormone preparations. And that was it. Nothing for arthritis. He really could do nothing in the way of broad surgery for many of the quite complicated things. He had some vaccines for some of the childhood diseases but none for some of the important diseases.

So if a person came down with pneumonia, you gave him good nursing care, and he survived or didn't, and about 20 per cent died.

Well, in a situation like that the physician as I saw him when I was young—I finished medical school in 1929—played a very important supportive role to the family when you had a seriously ill person. He was the only one who had any understanding of what was going on. He was the only one who could do anything, and although what he could do was limited, he spent a great deal of time both with the patient and with the family.

And when he made a house call, as was conventional in those days, he was welcomed by the mother if she had a sick child, by the father, and this type of thing.

At the present time the physician brings to the patient a tremendous amount of highly technical information. In many cases he has very definitive therapeutic drugs, preventive drugs, a large array of vaccines, a good understanding of nutrition and the ability to deal in a definite way with a great many ailments.

This puts him in the position of being much more impersonal in his approach to the patient, much more of a technician than a family friend, if you will.

I think this is basically the major reason for the change.

In addition to that, the physician, as well as the lawyer or the businessman, leads a more leisurely life now than he did 30 or 40 years ago. Doctors today take vacations. They

don't want to be up all night every night. They refuse to. They provide other mechanisms. So that the doctor is no longer always at the other end of the phone whenever anything happens.

Well, I don't think this is because the doctor has changed. I think this is because society has changed. We now have a 40-hour week. We work five days instead of five and a half or six. We're unwilling to be satisfied without substantial leisure time, whether you're a clerk in a shoe store or a physician or a scientist. In fact, I don't think scientists work now nearly as hard as they did when I was a youngster.

So, again, this has caused the patient to feel, rightly so, that the doctor doesn't exist only for him and his family. The patient or the patient's family now can get as frantic today as they got 20 years ago, but whereas the physician could not deal as definitely with a problem 20 years ago, he was willing to deal with the family and give it emotional support.

I think that everybody worked harder 30 years ago than they do today. I think it would be ridiculous to say to the medical segment of society: We're going to make you work just as hard in the '60's as you worked in the '20's. Problems today are quite different than they were in the '20's.

The medical help is there? It's simply being given in a different way?

That's right.

Do you feel the number of young men studying medicine is sufficient?

Well, we will have 10 years from now, I would guess, about the same ratio of physicians to population as we have now. And it seems that this is a reasonable ratio.

One of the things that is quite controversial and that remains unsolved is not the number of physicians but how effective they will be 10 to 15 years from now if our society does not develop a pattern of continuing education for physicians. The technical base for the practice of medicine is changing so rapidly that it's difficult for me to believe that a physician who graduates today at age 25 and practices for 40 years, in the absence of some systematic built-in, continuing education, will be an effective contributor at age 65.

Keeping abreast, in other words, of new knowledge?

Yes, but in a highly systematic way. It's done haphazardly now. Medical schools have postgraduate courses. Men go or not as they choose. Certifying boards provide for certification in specialties at one point in time. Medical licensing depends upon a certain minimum knowledge at a given time, and it is assumed from there on that the physician will maintain himself current with the advances of science.

I think this was quite reasonable to do in the '20's and the '30's and perhaps even in the '40's, but as the type of information now becomes more and more sophisticated it requires a broader understanding of fundamental processes if the physician is to be a continuing, thoughtful man who really understands that which he does and is able to make a suitable selection of alternative routes by which his patient can be treated. He will have to have more than he can get now in the way of a continuing education.

Is there any major disease which you feel could be completely eliminated through some new medical attack involving a massive research effort?

Well, I think the best prospect here is being approached now, namely, a fairly massive effort to understand and define the cause of hardening of the arteries.

One research group proposes to manage the diets of several hundred thousand people for a period of five to 10 years in order to see whether they can eliminate atherosclerosis to a substantial extent.

You might also say that respiratory ailments, including the common cold, are under intensive, highly engineered attack. These are disabling diseases. They cause disability, but not death. They are of importance to the businessman because they are the primary cause of absenteeism.

There are a series of experimental vaccines under development now, because it has become possible through multiple identification of viruses to pin down the cause of about 65 per cent of all upper respiratory diseases caused by viruses. Some of them in certain age groups individually can account for as much as 40 per cent of all respiratory disease in that group.

So it's not impossible, with a mixed vaccine, to prevent a very large proportion of those.

These are the only large engineered efforts that really have prospect of real success, and I don't see on the horizon undertaking any others of a comparable nature, at least not in the immediate future.

Do you feel we may have, in 10 years, extensive transplanting of organs?

Well, it's partially successful now in the case of the kidney. There are very extensive studies going on now in a number of laboratories that are trying to determine how the body's resistance to a foreign organ can be suppressed long enough for the new organ to take hold. I think there's reason to believe that it will be possible to achieve more transplants.

I think much sooner, however, there will be very dramatic developments in pumps and pump-aerator devices that will permit—for substantial periods of time—the complete release of the heart from its burden, perhaps when it's under particular stress.

We're pulling together all the people who are interested in this phase of work and seeing what they need in the way of additional engineering know-how.

Apart from heart applications, where else do these devices have promise?

An analogous situation is the so-called artificial kidney, where it's been demonstrated that with two treatments a week, you can carry a patient with no kidneys for an indefinite period of time.

The trouble at the present time is that it costs a well-run clinic about $10,000 a year just to maintain life for this individual.

For one patient?

For one patient, yes. That's assuming he's one of a group. If you have a group of eight or 10 patients, this is about what it costs per patient.

Now, again, this is under study from the standpoint of engineering design in order to determine whether it is possible to take this very complex engineering system and simplify it so that it can be used in a simple medical setting. The period of application, or washout, under present conditions is pretty close to 24 hours once weekly. This must be done in a hospital.

Now, if this can be modified and simplified, it is conceivable that it could be done in a simple medical setting with suitably trained personnel and would not require the extraordinary range of skills that presently are needed.

This is where the engineer's skill and know-how come in. The problem is well suited for a design engineer, much more so than the biologist who can define the problem but may not have the skills necessary

to find an answer.

Are there any other new, unusual solutions to illnesses in prospect?

I can tell you some of the hopes of some of the investigators.

There is at the present time no real fundamental understanding of any of the important diseases of the nervous system, particularly multiple sclerosis and amyotrophic lateral sclerosis, a disease of the nervous system which usually appears in adults. These are the big disablers in neurological disease.

But there has accumulated during the past three or four years a great deal of evidence that suggests that these diseases may, in fact, be started from viruses, with the initial infection quite far removed from the appearance of the disease itself.

All of these things will continue to improve over the next five or 10 years, but I don't think we will have the definitive solution for any of these problems by that time.

We hear a great deal about mental illness in America. Is its increase related to the way we live?

I think so. But the relationship is a curious one. The average individual is exposed now to much more environmental stress than he was 10 or certainly 20 years ago.

The stresses have risen that significantly?

Oh, I think so. The whole problem of urbanization in itself creates new stresses, and we are rapidly developing into an urban population.

The environment of the home and the strong support that a family center gave to our rural communities both protected the individual and limited his exposure and at the same time provided a local means of carrying the inadequate person without need of outside help.

In the larger homes of 30 or 40 years ago, the older person who was mentally incompetent could be contained within the family unit.

But in urban living, with small houses, with a predominance of apartments or two- or three-bedroom houses, there is less capability for this.

Is the United States ahead of, abreast of, or behind the Soviet Union or any other advanced country in medical research?

Put it this way: I think we have very good evidence that we're considerably ahead. However, the best medical scientists in the Soviet Union are no better or worse than our best medical scientists, and we have had enough interchange to know this.

On the other hand, our strength is in depth, and their strength in terms of really top-flight scientists is much more limited in numbers in proportion to the problem.

In certain fields we far outstrip them. In other fields they probably have a lead.

Do you look for the Russians to burst upon the world with any breakthroughs in medicine in the near future?

No.

What percentage of the nation's annual $1.7 billion medical research investment is federally supported today?

About 60 per cent.

Do you feel that it is desirable to maintain a balance of about that amount?

I don't think there is anything magic about it, but the present proportion seems reasonable, workable, and effective.

From what you know of medical research outside of government, do you feel there is more that could and should be done there, or do you feel they are working about at their rated capacity?

I think that we are still in a period of growth, and I think over the next five years there will be a substantial increase in the expenditures that support the medical sciences, because some of the areas we haven't talked about are just beginning to be developed.

For example, our stake in behavioral sciences right now is minimal, and yet locked within the knowledge that will be derived in those fields are understanding of the learning process, development of speech, the origins of our emotions, the understanding of the problems of the developing child.

It is out of such studies that will come answers that are applicable to problems of juvenile delinquency, to problems of drug addiction in the young, to behavioral problems of children generally; not from the study of the disabled child but, rather, studying the beginnings of these disturbances against normal evolutionary processes.

Broad areas that are yet uncovered have to do with the developmental process of the human himself, the factors that affect his development before birth, many factors that relate to the inherited composition of a child, and, in fact —at a later time—perhaps the ability to modify that composition. **END**

Nation's Business

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TAB 32

SCIENTISTS AND GOVERNMENT

Brandeis University

April 8, 1964

Dr. J. A. Shannon
National Institutes of Health
Bethesda, Maryland

I. Present relationship of scientists to government evolved largely from national need for science at times of crisis.

A. Wars--first the Civil War, then World War I, and particularly World War II--led to dependence on science and ever stronger Federal support.

B. Threat of epidemics during great period of immigrations in 1880's led to Hygienic Lab, and the later rise of chronic disease led to expansion of NIH.

C. Following World War II, with its impressive evidence of the importance of research, support of science has become predominantly Federal, with firm commitments for continuing programs.

1. Between 1950 and 1963, all R & D rose from $2.9 billion to $18.5 billion. More rapid growth than GNP.

2. Federal share went from $1.2 billion to $14.7 billion, rising as a proportion of all R & D.

3. Federal Government supports 60 percent of all research conducted by industry (1961) and over 70 percent of separately budgeted research in universities (1958).

4. Of $736 million spent for R & D in colleges and universities in 1958, $538 million came from Federal sources.

B. Government now depends on scientists; scientists on government.

E. There is now widespread recognition that intellectual capability is vital to national strength.

F. Increasing costs of research, changing tax structure, and other complex socio-economic factors have led to scientists' dependence on Federal Government (with all due recognition of continued importance of private sector).

II. What we seem to be saying is that the scientist is in harness, the Government is holding the reins, and all that need be done is to continue to furnish the hay. This is far from the case.

A. The continued [illegible] depends upon factors that are by no means guaranteed under the present circumstances.

1. Leadership, particularly in developing new fields and shifting from the [illegible] need intelligent [illegible] at all levels.

2. Adequate [illegible]

3. Ability to gain, disseminate, and put to use new knowledge.

4. Broad acceptance of science by [illegible] the general public [illegible]

5. [illegible]

B. The [illegible] Federal structure of responsibility entails [illegible] upon the Nation's capability and willingness to meet these needs.

III. Evaluation of present conduct of science in terms of above: Is the framework adequate?

A. Leadership and management.

1. Need national leaders whose understanding and position in science are sound.

2. Support of science should have a broad, definitive national policy.

3. Need responsible management at the [illegible]--in the [illegible] where science is conducted.

B. Environment for research.

1. National climate still lacks appreciation of basic research and fails to provide a forum for developing the rationale aspects of public policy.

2. Institutional environments often lack optimum balance between research, teaching and services.

3. [illegible] the government level, the thrust of scientific endeavor is in danger of being blunted by the zeal of legislative committees to regiment expenditures. [illegible] a modicum of bureaucracy into the system.

[illegible] ability to enrich our purposive knowledge is largely a reflection of two conditions:

1. The amount of basic research, since this is necessary to replenish the pool of knowledge. Must consider ratio of basic to applied.

2. Adequacy of support for the teaching function. Needs direct, unequivocal recognition in national policy.

D. Program stability: must keep support coming from all sectors.

1. Reasons for continued private support of research.

2. Manpower requirements.

E. [illegible] and [illegible] be [illegible] strength and vigor [illegible] [illegible] ground [illegible] [illegible] far to go.

1. "Science and public policy" should be a required subject in every undergraduate college curriculum.

2. Other [illegible] [illegible] to better public [illegible].

F. Adequacy of [illegible]:

1. Expand [illegible] [illegible] to [illegible] accumulate [illegible] [illegible] [illegible].

2. [illegible] entire structure rather than top [illegible] alone.

IV. The scientist's relation to government, then, is one of mutual dependency, in which certain requisites must be understood by both parties and other interested groups.

A. This relationship has come about through the interaction of complex trends and cannot be safely altered through superficial approaches.

B. It is generally and fundamentally sound today.

C. Its future depends upon the relative strength of certain forces working for and against the structure, such as the efforts of enlightened legislators and leaders, on the one hand, and the weight of bureaucratic interference on the other.

V. [illegible] problem of national support for graduate education and research [illegible] a new [illegible] for a new [illegible] of higher learning, as emphasized in [illegible] Federal Support of Basic Research in Institutions of Higher Education" by the Rockefeller Brothers Fund.

A. Need to improve administration of grants in the universities.

1. Improve accounting.

2. Examine mechanisms for review of grant proposals.

3. Develop rational, efficient policies for training graduate [illegible] programs.

--

B. Relation of graduate education to basic research needs re-emphasis.

1. Two trends could lead to impairment of this combination:

a. Basic research facilities that are located away from university centers.

b. Lack of strong policy on the balance between research and teaching.

C. Indirect costs, potential source of friction--

1. Between government and universities.

2. Between investigators and university administration.

3. Indirect costs impact responsibilities on both the conduct and [illegible] of [illegible].

D. Institutional and general research grants tied to the project system should be extended.

E. Development grants to alter the geographic distribution of Federal funds should be launched.

1. Should go to institutions with potentiality.

2. Task force needed to study issues.

3. Development grants should be phased out after they have served their purpose, leaving project system and institutional grants.

F. This would all tend to strengthen the permanent interrelated system.

1. Federal agencies and the universities should have strong policies regarding basic research support.

2. Urgent problems before the Congress and the Executive must be solved.

G. Scientific community also has a role to play.

1. Obligation to advance knowledge, but also to educate the young.

2. Must serve on panels, etc.

3. In accepting funds, the investigator accepts a trust to render conscientious effort.

H. Much is at stake and much remains to be gained for the welfare of mankind through cooperation that will strengthen the partnership of the Federal Government, the universities, and the scientific community.

# # #

TAB 33

JUL 2 2 1964

Dear Dr. Hooper:

Enclosed is a somewhat edited and extended version of the remarks which I made at the Standing Committee's ~~[illegible]~~ Symposium.

Sincerely yours,

(Sgd) James A. Shannon

James A. Shannon, M. D.
Director

Dr. William L. Hooper
Executive Secretary
Standing Committee of Federal Council
Office of Science and Technology
Executive Office of the President
Washington, D. C. [illegible]

Enclosure

TJKennedyJr:lm 7-17-64

Yellow box copy located in CD-HE Files

Dr. Astin, Dr. Weinberg, Dr. Price, Ladies and Gentlemen:

My thoughts will not be as well organized or as beautifully articulated as those of my predecessors, Drs. Weinberg and Price; however, my convictions about their validity are very deep indeed.

It's very fashionable these days to be concerned with the problems of scientific and technical information. This convocation of people of your stature and with your responsibilities, under the aegis of the Standing Committee of the Federal Council, suggests the high priority attached to this matter by the latter body. However, I have as yet not been able to perceive, understand or grasp elements in, or dimensions to, this problem which warrant the alarmist comments one hears from certain--not entirely disinterested--quarters. However, I intend to continue to explore the issues, largely by dialogue with people from other parts of the scientific and technical community, examining the differences between their world and the biomedical area with which I'm familiar.

One major impediment to progress which I regularly encounter is the rather universal tendency to state the issues in broad and sweeping generalities; the other side of this coin is the crying need to formulate the problems in specific terms, recognizing and highlighting, rather than blurring, distinctions. A number of such distinctions might be suggested. It seems to me that the nature of the problem is conditioned by the field of science under discussion; in this context it is possible

to discern very important differences between physical scientists and engineers on the one hand and, on the other, the biomedical scientists and physicians. Again, the function to which information is put would appear extremely critical in the assessment of the value of any proposed solution to a specific problem. The needs of a scientist will never be met by a system designed from the specifications of an administrator or manager; and surely it is not profitable or possible for an administrator to immerse himself into the substantive detail of which a scientist must be master. I make these distinctions only to re-emphasize that the science information problem is many problems and that action programs must be developed from more precise problem statements than most viewers with alarm have taken the trouble to formulate.

As I mentioned, my views are strongly conditioned by my experience with the institutional forms operating within the biomedical community for exchanging scientific information. It has long been my feeling that the biomedical sciences function today in a fundamentally sound tradition, and that gradual evolution through adaption to modern technological developments, rather than through a revolution which disavows and destroys this tradition, is the appropriate objective to be sought in scientific and technical information programs. I was, however, sufficiently open to persuasion to the contrary that I asked the Division of Medical Sciences of the National Academy of Sciences, National Research Council, to survey the contemporary needs of the biomedical community as seen

through the eyes of that community itself. Needless to say, the fact that the distinguished committee of scientists convened by the NAS-NRC adopted in a recently published report a posture that was low key and evolutionary was reassuring.

Let me review briefly some essential elements in the traditional mores and the biomedical scientific research community both as such and by contrast with the state of affairs elsewhere. The medical and life sciences are in the fortunate condition that a number of things are working for the scientist and a number of things which work against the scientist have never gained a foothold. Dr. Price's reservations to the contrary notwithstanding, our literature is open and, while their number is large, published journals may be purchased on the open market, collected, scanned, indexed, etc. Most important biomedical literature has been systematically collected -- most comprehensively and since 1836 by an organization now known as the National Library of Medicine -- and many large repositories are scattered across the land. Responsibility for bibliographic control of the medical literature has resided in the National Library of Medicine and its predecessors and an index to this body of literature has been published without interruption since 1879; the scope of the index is constantly expanding to include cognate life sciences. The most recent modernization of the techniques for processing the index for publication provides ancillary capability to compile with speed and facility both recurring and demand bibliographies,

citations for which are selected on the basis of the 5-30 descriptors assigned to each scientific paper in the (non-automated) indexing operation. These characteristics of the biomedical literature warrant, in my view, its description as 'open'; they also facilitate access to the information by users, i.e., they work for the scientist. I believe that this state of affairs is in sharp contrast to the situation consequent upon extensive use of the 'technical report' as a vehicle for communication of scientific and technical information.

The biomedical research community is almost totally unacquainted with the technical report literature so familiar to DOD-, NASA-, AEC-oriented research and development institutions; no counterpart to this mechanism can be recognized in the instrumentalities for transmission of biomedical scientific and technical information. Again this may be related to our traditions. Information is not viewed as definitive or examined seriously, until it has survived the editorial processing procedures and found its level of excellence in the hierarchy of journals. There is no announced quality ranking of biomedical journals. But within each sub field, a very broad consensus obtains on this rank ordering. Even in the contemporary 'publish or perish' culture, superiors who make decisions to promote, to give tenure, etc., not only tally the count of publications but apply a weighting coefficient reflective of the esteem assigned to the journal cited. And herein lies a key point. The wise scientists and scientist administrators are able to face the

literature explosion with considerable equanimity, because their intuitive evaluation of the quality of journals, solidly grounded in experience, gives them a way of living with the consequences of 'publish or perish'. The editorial processing procedures roughly segment the published literature into subsets which do not all merit equivalent attention; erroneous judgments occur but their probability is sufficiently small to warrant the risk.

The biomedical community will, I hope, continue to insist on open publication after rigorous editorial processing for its obvious advantages and to resist pressures directed at establishing the counterpart to the technical report literature, because of the obvious disadvantages. While the merits inherent in the prevailing system are considerable, improvements are possible and should be pushed. The control over quality achieved by these procedures is time consuming and delays publication. It is important to assess the significance of this delay and, out of such an assessment, to compare the expected benefits with the cost of action designed to reduce this lag.

Basic to the question of the significance of delay is recognition of the fact that in the biomedical research community, interpersonal exchange has always played an extremely important role in scientific communication. Every spring there are two major occasions on which research workers foregather to discuss work in progress. The pre-clinical

sciences, under the aegis of the Federation of American Societies for Experimental Biology, is meeting this very week in Chicago. Among the 16,000 registrants--perhaps 75% of the total potential attendance--are the bulk of your counterparts from the NIH. Next month, the Clinical Investigators, about 3,000 strong, will convene in Atlantic City under the auspices of three independent societies, two of which are lineal descendants of the original. Virtually one hundred percent of the anticipatory abstracts submitted to each society are published prior to these meetings and, in toto, portray with accuracy and timeliness the frontiers of scientific research.

These spring meetings are of incalculable value for scientific communication and information exchange in the pre-publication phase of work. To a very large extent their existence vitiates the significance often attached to the statistical presentations of the lapse of time between the completion and the publication of research. The encounter of men and ideas which occurs in the formal sessions of the meetings, as well as informally elsewhere, is enlightening both to the scientist with ideas and data to talk about and to the colleague who listens, criticizes, confirms or challenges. Now it is certainly true that the rapid growth in the population of scientists we have witnessed in recent years, and its reflection in the size of the registration figures at these meetings, has taken some of the coziness and clubiness out of them. On the other hand, it is important to avoid falling into the

trap of concluding that the meetings are now so big as to have lost virtually all of their traditional value. At any point in time, the number of investigators interested and working in an encompassable field of biomedical research is small. This, in my experience, has always been true; the growth of science simply has increased the number of fields. Thus, these meetings continue to allow most scientists to get together with the colleagues with whom they wish to converse, and to interact to the extent they choose with people in contiguous fields. In short, the problems occasioned by a scientific meeting with 16,000 participants are no more dismaying than those accruing from the publication of 50,000 journals. No single individual can read the latter or enter into dialogue with the former; neither of these numbers relate to the real science information problems facing the working scientist.

Recognition of the proper role and effective function of the scientific meeting goes a long way toward discounting the significance that can be inferred from a straightforward recital of the statistics related to time lag in publication, as well as toward justifying the price in delay for the benefits of editorial processing.

In this connection, a couple of other observations may be in order. There has been a considerable amount of discussion directed at formalizing (through publication) the informal information exchanges which take place in meetings. Dr. Price, in publicizing the role played by the small,

ad hoc, and loose confederation of cognoscenti--colorfully identified by revival of the term "invisible college"--in the exchange of information relevant to a particular and especially a fast moving field of science has provided impetus to such ideas. Again, alternative solutions seem preferable. The informal should remain so, but every effort should be made to find ways of making the "soft" and unpublished information in the possession of the closed group more readily available, not to everyone, but to those who want and need it. I rather suspect that most people able to contribute to, and capable of deriving immediate benefit from, the transactions of the 'invisible colleges' have more or less direct entree to them, and that criticism comes largely from those who feel they have been subject to discrimination.

In any examination of the information problem in the biomedical sciences, the distinction between the problems faced by the scientists and those confronting the documentalists must be carefully examined. I am personally convinced that too many papers are written, and concur with the theses of Drs. Weinberg and Price that many are poorly written and that the submission of others for publication is of dubious ethical justifiability. And thus, there is an almost irresistible urge to winnow both manuscripts submitted for publication and the published literature. On the other hand, the historic reality that judgments of the excellence of scientific papers have been fallible, with serious consequences to science, temper one's enthusiasm. Moreover, as Shockley has pointed out, frequency of publication is--however poor--the best available objective measure of a scientist's competence.

I can only conclude that the tradition in the biomedical sciences--in which part of the process of becoming a good scientist is acquiring the ability to recognize the good journals--is a reasonable compromise.

On the other hand, the documentalist has no choice. Every published paper must be viewed as of equivalent worth and, if at all possible, be collected, catalogued, indexed, stored, etc. The problems which confront documentalists are challenging and interesting; they do not, however, appear to be at the true conceptual center of the science information problem. The magnitude of the load with which the documentalist community will have to cope in the next decade may be approximated from manpower projections. The possibility of growth of the size of the research manpower pool in our field over this period to more than double its present size is not likely and suggests the probability that the number of published biomedical scientific papers will approximately double. Problems of balancing the Federal budget and the consequences of diminution in the intensity of the cold war may result in an even smaller rate of growth of the manpower pool in the physical sciences and engineering. These projections suggest that the documentalists' problems are overstated by terms such as 'crisis' and 'explosion', and that we should rather thoughtfully and deliberately formulate plans to meet problems of the predicted order of magnitude. There is plenty of time to solicit user (scientist) participation and to make judgments about the desirability of incurring the probable costs of the various alternative solutions.

The scientific review or monograph has been a most useful device for compacting the literature, winnowing out inferior work on the basis of the taste and critique of the expert. In our field, there are plenty of reviews published; the need is for truly critical reviews. Scientific papers have become bland documents with less and less of the hard-nosed criticism of the work of colleagues which characterized the literature of a few decades ago. Perhaps the revival of an attitude of responsibility toward the documentation of the state of knowledge in a field, including the resolve to expose the shoddy, the vacuous, the trivial and the tasteless, is a desirable goal in the development of a code of ethics for scientists.

The science administrator is faced with problems of a rather different nature and these should be accorded separate treatment in discussions of the scientific and technical information problem. Administrators are layered in a hierarchical order, characterized by the need in higher echelons for increasingly general and broad (versus specific and detailed) information about an increasingly wide band of the spectrum of science. In addition, the further away the administrator from the bench, the more important become the questions related to considerations such as space, funds, manpower, etc., as well as to the allocation of these resources among competing requirements. In this area, there is much to be done, if the administrators are to be made to feel more secure in their decisions than I, at least, do at present. Most managers need not only better data, but also better systems to acquire,

store, manipulate and analyze the data. Methods to detect overemphasis or underemphasis of specific areas, to identify emerging trends, and to provide early alerting to changing patterns should prove most useful in administrative operations and in managerial decision making. In my efforts to improve my own agency's management information system, I have encountered two major types of problems, one technical and the other human. At the technical level, the classification problem in all its multiple facets is--as always--knotty and recalcitrant; today's solution to any part of it has a disturbing tendency to become obsolete or irrelevant in all too short a time. The human problem is worse. The reluctance of members of my staff to grapple with these problems on philosophical grounds, and their assertion that many apparently legitimate managerial questions are unanswerable in any absolute and systematic way gives me some pause. They fear that managers will soon forget the arbitrary elements in the assumptions which made practical some statistic description of the universe and will make decisions of far-reaching consequence upon data that is of extremely limited meaning.

Two other problems concern me. The one is the systematization of processes to get research information rapidly into the hands of our ultimate consumers--physicians--to be applied to the maintenance of health and the elimination of disease. This problem is uniquely related to the Public Health Service's mission, but has many aspects analogous

to those encountered in informing the practicing engineer. The other is in providing useful information to the public. This latter is a difficult and serious one, and the stakes are high. The national effort in biomedical research is currently heavily dependent upon Federal funds and is likely to continue so. This means that the soundness of national policies will depend in large measure upon the extent to which the citizenry and their representatives in Congress are informed about science. Thus, I feel a grave obligation to be heavily engaged in the task of educating the several "publics" in the dynamic and evolving aspects of biomedical science. This task, considering the variety of backgrounds represented in the "student body", is formidable. But it needs doing and doing well.

In summary then, I discern a number of discrete problems which will, over the next decade, require increasing attention and systematic, calm and deliberate attack. Deficiencies must be recognized and corrected in traditional and prevailing scientific and technical information exchange instrumentalities, without surrendering to the position of the prophets of doom and gloom who--not without vested interest--wish the situation to be portrayed as chaotic. Most of all, I would plea for sharper problem definition, so that concrete plans can be formulated. I would welcome surcease to extravagant charges such as the existence, entombed on library shelves, of the cure for cancer.

TAB 34

Science and Federal Programs: The Continuing Dialogue

James A. Shannon

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Science and Federal Programs: The Continuing Dialogue

Academic values can be extended in the context of major support derived from public sources.

James A. Shannon

To address this distinguished group is not only an especial honor, but also a welcome opportunity to express some personal views on certain aspects of a matter which is demanding increasing attention from all of us. I refer, of course, to the vital and complex relationships evolving out of the federal government's major involvement in the support of science. I am prompted to an informal exploration of this subject by the superb presentation of the problems of this relationship and the wise conclusions drawn in the recently issued report of the Committee on Science and Public Policy of the National Academy of Sciences, developed under the able chairmanship of George Kistiakowsky.

In the present stage of national consideration of these matters, I think this report is most timely and contributory. I believe it also to be clear confirmation of the important historic function of the Academy in providing advice to the federal government and leadership to the scientific community in matters vital to the advancement of science in the national interest at a time of important change. My comments have been engendered by reflecting upon the issues of "federal support of basic research in institutions of higher learning," as presented in the Kistiakowsky report.

It is now possible to view the progress and support of science in some perspective after a period of intense growth and change. It is also possible in this process to see issues emerging which are broader than research and technological development—broader than science itself, for they encompass major national needs relating to higher education and the very basis of scholarly activity. It is my hope that these remarks will evoke discussion, now and henceforth, and sharpen our perception of the issues. This, in turn, may contribute to the further resolution of the continuing dialogue relating to national policy on science and its support. It is through this continuing dialogue that valid concepts must come for guiding the legislative and executive branches of government, as well as the scientific community and its institutions, in the formulation of sound policies.

The author is director of the National Institutes of Health, Bethesda, Md. This article is adapted from an address delivered 28 April before the National Academy of Sciences, Washington, D.C.

The Appeal to Science in Times of National Crisis

History reveals that science and technology have been of particular concern to the federal government in times of national crisis, when urgent national problems reveal deficits in our knowledge. Although the founding fathers of our nation were preoccupied with science and its role in government, no lasting federal relationships were established until the Civil War. The need to provide for scientific assistance and advice in a time of peril is in a very real sense the event contributory to the founding of the National Academy of Sciences. In a similar manner medical research in the Public Health Service had its birth in the threat of grave epidemics during the great period of immigration in the 1880's, in the context of beginning scientific knowledge and capability deriving from the germ theory of disease. Thus, the Hygienic Laboratory, originally set up at the port of New York, evolved into the National Institutes of Health.

World War I was the next major crisis that compelled the federal government to call on the nation's scientists in a large-scale manner. The existence of a burgeoning industry bereft of basic scientific support from abroad led to a search for technological and scientific aid from American scientists and institutions for the solution of war-born problems. Accordingly, the Academy established the National Research Council as a practical

means of making science available to federal agencies.

Finally, and within the memory of all of us, there was the great scientific and technological effort undertaken amid the rigors and perils of World War II. Science and technology, particularly science in the university setting, were directly engaged through the Office of Scientific Research and Development. This direct involvement of university science in the service of public needs, albeit needs deriving from prosecution of the war, constituted the beginning of a momentous relationship. The transfer of the residuals of this program to NIH on the one hand and the Office of Naval Research on the other, at the close of the war, set the stage for the forging of a major and lasting commitment between the federal government and the universities and the scientific community, as the nation turned its resources to the preservation of peace and the meeting of human needs. Thus, a relationship born in crisis has, because of the force and consequence of scientific development and the course of human events, become a crucial dependency.

Implications of the New Dimensions

This set of circumstances has implications quite different from those of the earlier federal involvement with science, and obviously a more far-reaching significance to our institutions of higher learning. First, it is of great magnitude: expenditures for all research and development in the United States were in the neighborhood of $18.5 billion last year. Second, it has the elements of permanence, as indicated by the fact that R&D has risen from 1 to 3 percent of the gross national product since 1950 and now is unquestionably of major national concern. Finally, the current support might be described, for the most part, as special-purpose and built upon the project concept—a paramount characteristic from the standpoint of the university.

I will not minimize the importance of past general-support programs of the federal government in areas relevant to science. The development of the university structure in this country, for example, owes much to the land-grant program of the 1860's. Scientific investigation was furthered by the broad federal support of agriculture and agricultural industry, and by the programs of the Department of Interior concerned with the exploitation and later the conservation of natural resources. But in magnitude, impact, and timing, these movements progressed at a slow rate, permitting absorption of some program elements and adaptation to others without striking modification of the concurrent academic scene.

The present events, on the other hand, derive mainly from a major new set of programs that are large in scale and have an accelerating rate of growth. The thrust of major components of the federal government concerned with science today is predominantly oriented toward specific missions. This is clearly represented by the nature of the basic responsibility of the major federal supporters of research: the Department of Defense, AEC, NIH, and NASA. Even NSF is special-purpose in that its programs are confined to science alone. Thus, programs addressed to specific objectives and employing the "project-support system" predominate today in the federal support of science, and their impact is strongly felt by scientists, institutions, and education in general.

Here it may be well to comment on what I believe to be some of the values of the project system of support, since some of my subsequent comments may sound negative or at least critical of this basic mechanism. The development of the project system over the past 15 years has brought clearly to the fore these values:

1) The system is well suited to meet specific short- and middle-range scientific and technological needs of a mission-oriented program.

2) It permits early emergence of scientific competence within institutions with quite complex missions relating to instruction, service, and research.

3) It substitutes excellence for political considerations as a guide to support, and I use the term *political* here to encompass the many considerations apart from strict scientific merit which might bear upon the distribution of support.

4) The project system makes possible access to multiple sources of support and diminishes dependence upon the terms and conditions of a single source.

5) The project system helps strengthen the scientific environment within which the work is performed, through detached assessment of staff capabilities and through maintenance of vigor within the environment.

These are really important contributions to the environment of scientific activity. In fact, the project system has operated in this country so well, and has benefited all elements of the science structure to such an extent, that most, if not all, agree that any modification of federal support programs in science should have as its takeoff point a continuation into the future of much the same sort of programs and program mechanisms that obtain today.

However, there are broad deficiencies in our current support system as it operates today, and these become increasingly important as one takes the longer-range view.

Federal Expenditures Dominant in University Financing

The magnitude of federal expenditure directed toward universities, when measured in all its dimensions—research, training, construction, student support—is enormous. In 1963 the colleges and universities of the nation received approximately $2.5 billion from the federal government; in 1964, $3 billion. New legislative authorizations will add an estimated $580 million in 1965. These totals represent upward of a quarter of all university income; in some institutions the proportion reaches 50 percent.

As I have noted, most of this support is for mission-oriented objectives, only minor amounts being left for the institutions and education as such. Federal support to schools is predominantly for research—$1.6 billion in 1963—and this, by and large, is "project" financing. This fact, coupled with the thrust of science in the 20th century, has elevated research to a position equaling and perhaps higher than that of education itself. What are some of the implications of this trend?

One is the tendency to relate senior faculty members to the diverse sources of funds, diminishing their tie to the university in a fundamental sense. The university is now felt to be the scientist's boarding-house rather than his intellectual castle. Thus the concept of the university as a precious and necessary environment for scholarly activity has, to a large degree, been lost.

The paragon of academic attainment

today is not the scholar but the productive scientist. There has been an erosion of the concept of scholarly detachment and its essential contribution to human knowledge, endeavor, purpose, and achievement. Yet strong, intellectually independent institutions of higher learning centered upon the protection and enhancement of scholarship are indispensable national assets. There is need, then, for a coherent body of principles which recognizes this point and provides a basis for intelligent, purposeful national action in terms of present and future demands for intellectual resources.

The new principles should relate federal support, in its present manifold terms, to institutions of higher education as such, and to the higher-educational process. They should provide a means of extending the support of mission-oriented research and development to the advancement of science in general. And they should relate the advancement of science, as *science* is understood in current restricted terms, to education and the broad furtherance of scholarly activity. The general objective, then, is to evolve a framework of relationships which will permit the pursuit of national goals while furthering all the basic university functions.

Obstacles to the Formulation of New Principles

We should recognize the complex circumstances that interfere with the development of such a coherent body of principles. Among those circumstances is the traditional role of private institutions as guardians of academic excellence and intellectual independence. So strong is this tradition that it generates resistance to the concept that such academic values can be extended in the context of major support derived from public sources. Yet, in the national interest, they must be extended. The prevalent traditional fear of the government's intrusion into education is a further obstacle, since it militates against a broader federal role in support of the educational function.

Thus, to date, no means has been found, and no national intention has developed, to deal *generally* with institutions of higher education, significant as they are as entities in respect to the national destiny.

We have rationalized the agency sprawl which constitutes today's government-university relationship as providing the benefits of diversity of support. We have ignored the destructive impact of this random set of processes upon the integrity of the university and the concept of the scholarly community.

Moreover, the situation has led to a domination of the government-university scene by federal agencies whose missions currently receive the major share of public support. This has diminished the significance of the agencies with broader roles, such as the Office of Education and the National Science Foundation. The resulting imbalance of university programs is distorting to institutional objectives and thus falls short of meeting long-term national objectives.

The resolution of this set of problems is complex, since it calls for a national consensus on the long-term importance of intellectual effort and the resources that contribute to it. Such a consensus must be reflected through the Congress. But the scientist, the scholar, and the teacher must also comprehend the indispensable role of the university as an institution centered upon preserving and furthering the values that are essential to intellectual activity.

The federal agencies, so long as diverse missions are the basis of support for academic science, must seek new means and arrangements permitting a significant contribution to the institution as a whole rather than just to the relevant parts. In this, the enunciation of broad principles and objectives by the Academy and by university groups is of great value in guiding the legislative and the executive branches. With a general understanding of the concepts and goals, the Congress, the federal agencies, and the nation's institutions of higher learning could effect a purposeful and productive evolution in the system of science support. This would be in the direction of designing a system to further broad, long-term objectives as well as to meet specific short-term needs.

A crucial dependency among the federal government, the universities, and the scientists is the hallmark of the present era of national development. With all its problems and many dangers, it provides, perhaps for the first time, a setting in which this nation can comprehend the vital nature of its intellectual resources and formulate the means to bring public support to bear on their cultivation in such a manner that the conditions necessary for intellectual achievement are sought as a paramount public good.

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Dr. James A. Shannon
Dedication Ceremony, Kettering
Research Laboratory
New York City
May 6, 1964

Dr. Horsfall, distinguished members of the Board of Trustees, ladies and gentlemen: I am happy to join with the many friends of the Memorial Sloan-Kettering Cancer Center for the dedication of this new Kettering Research Laboratory. I welcome this opportunity to reaffirm the spirit of cooperation and partnership that has marked the association of the Public Health Service and the Institute from its very beginning.

Since it first opened its laboratories in 1945, the Institute has found it necessary to expand several times not only to meet the increasing demands of its research program but to take advantage of the scientific opportunities envisaged by its staff. Its domain now includes the "old" building across the street, the Walker Laboratory at Rye, and this fine new Laboratory.....a cancer research complex that symbolizes Sloan-Kettering's eminence in the field.

I recall that in 1947, the Institute made history by becoming the first organization capable of launching a broad and intensive program of integrated laboratory and clinical research dedicated to the control of cancer in man. In the intervening years, its research program has expanded until, today, it encompasses all the major fields of cancer research.

The Institute has done much pioneer work in several of these fields; it has performed meritorious service in all of them. And it has made particularly significant contributions to the nationwide cancer chemotherapy program and to the study of cancer-virus relationships.

It is generally agreed that, in addition to long term stable support, the most important resources for cancer research are trained manpower, a base of knowledge to use as a springboard for future investigation, organization, and physical facilities and equipment.

Sloan-Kettering has all of these resources. It has several thousand fully-trained scientists on its rolls, with highly dedicated leadership at the top. Its fund of knowledge, increasing year by year since its entry into the cancer research field, provides an enviable base from which future investigations can be launched. As an organization, the Institute can draw on twenty years of experience in cancer research and allied activities. And, when this building is fully occupied, the Institute will have at its disposal approximately one-tenth of the net square feet of laboratory space devoted to cancer research in the entire nation.

Within the past few years, advances in cancer research and important additions to the body of scientific knowledge in related fields have magnified the challenge, increased the opportunities, and changed the very scope of research in this area. The relationship of recent biological developments to physical and chemical

factors already recognized as playing a role in the origin of cancer has opened up new areas of investigation.

One response to this situation was the decision of those who direct Sloan-Kettering's destinies to expand the Institute's research program by initiating a major effort "to determine the course of internal events in the genesis of cancer," without slackening pace in the search for better methods of treatment.

One result of their decision is this Laboratory we dedicate today. By embracing literally dozens of areas of cancer research, this much-needed facility will bring to bear all of those scientific disciplines relevant to its problems. It will foster the essential interchange between the clinical and research programs. It will enable the Institute to apply recent scientific findings more effectively, and foster the search for even greater advances which our present state of knowledge indicates can be made in our own generation.

Most of you are familiar with the old laboratory building across the street and will readily recall the statement that appears on the wall of the ground floor lobby. It reads, "Within these walls a few labor unceasingly that many may live." Now, the very walls have multiplied appreciably; the few are not so few; but the labor is just as unceasing and, because of that inspired labor, many, many more will live.....and enjoy life.

From inspiration comes aspiration, and it is my firm conviction that the investigations conducted within these walls will contribute to the ultimate defeat of one of our most cruel enemies, cancer.

In viewing this building, with its varied facilities and sophisticated instrumentation, I cannot help but ponder for a moment on how much the Kettering Research Laboratory would have delighted Dr. C(ornelius) P(ackard) Rhoads, had a kinder fate spared him for this occasion. The Sloan-Kettering Institute and its research programs were Dr. Rhoads' consuming passion for the last fifteen years of his life; they were nourished, as Dr. John Heller so aptly expressed it in his eulogy of Dr. Rhoads, by "his unusual combination of administrative ability, scientific direction, and executive leadership."

Since Dr. Rhoads' tenure, capable hands have taken up the burden and, in a large sense, provided extended life for his fruitful policies and high order of leadership. This imposing structure is a tangible demonstration that his ideals are your ideals.

For -- and I bow again to Dr. Heller -- Dr. Rhoads "wanted his associates to have the best possible environment in which to live and work. He wanted them to feel encouraged and, above all, to succeed."

I can conceive no better place to achieve those goals than here.

# # #

Health Research Facilities Grants to Memorial Sloan Kettering Cancer Center

Completed Projects	
New Building, New York	$ 2,579,944
New Building, Rye	1,152,750
Under Construction	
New Building, Rye	1,750,000
TOTAL	$ 5,482,694

Memorial Sloan Kettering Cancer Center Research Grants & Awards, FY 1963

	Number and type of award		Amount
	35	Research Projects	$ 3,931,023
	5	Training Grants	480,973
	8	Traineeships	82,007
	1	Fellowships	7,500
	7	Research Career Awards	105,534
TOTAL	56		$ 4,607,037

A LOOK AHEAD AT HIGH LEVEL MANPOWER RESOURCES AND REQUIREMENTS

Statement of
James A. Shannon, M.D.
Director, National Institutes of Health
before the
Joint Sessions of the Engineering Manpower Commission
and the
Scientific Manpower Commission
May 21, 1964

I. Introduction

I have been asked to look ahead at the next ten years, focusing upon the relationship between resources of highly qualified personnel in the sciences and engineering and the requirements of our rapidly developing civilization. This is a large order. However, as the new President's Committee on Manpower has discovered, a wondrous proliferation of published projections is readily available. And most of you are well aware of the outpouring of manpower studies prepared by or for PSAC, NSF, Department of Labor, HEW, NIH, and the National Academy of Sciences. Consequently, I do not intend to rehash or digest these readily available reports. Instead, with your indulgence I should like to (1) contemplate factors influencing demand for high level manpower over the next decade, (2) reflect, somewhat philosophically, upon our approaches to expanding our supply of scientific and professional manpower since World War II and (3) speculate about the nature of the job ahead and how it might be accomplished most effectively.

II. Diverse and Complex Forces Influence Demand

As the Gilliland Panel acknowledged, forecasts of demand for scientists, engineers, and other professional personnel do not furnish a sufficiently firm basis for the formulation of manpower policy. In a relatively free economy and an enterprising social climate, such estimates, at best, reflect predictions of the ability of the economy to absorb

possible increases in supply. When I say "at best", I mean if assumptions hold with respect to the changing structure of the economy, the rate and direction of technological change, the investment in and returns from R & D, the character of public commitments, and other critical variables. Such caveats are necessary lest we look ahead with irrational precision. But such caveats should not deter us from discerning the shape of the future.

We shall require high-level manpower resources in an ever-widening array of sub-disciplines to meet the demands of a dynamic, diverse, complex society. Illustrative of these demands are:

- The staffing of institutions of higher education during the period of their most rapid expansion. Americans have heeded Alfred North Whitehead's dictum:

  "The race which does not value trained intelligence is doomed."

- The development of new technologies, new products, new processes to improve our material and social well-being.
- The application of the skills and techniques of the physical sciences and engineering to the study of biomedical phenomena utilizing more precise instrumentation, simulation devices, seromechanisms, and biomedical engineering.
- The application of scientific capabilities to the improvement of essential public services -- transportation -- communication -- housing -- health and sanitation -- recreation.

. The export of science and technology. Toynbee has commented that our age may be remembered as the first in which "mankind dared to believe it practicable to make the benefits of civilization available to the whole human race."

III. In Retrospect

1. Many Federal agencies -- AEC, NSF, NIH, NASA -- have initiated and greatly expanded manpower and training programs since the close of World War II. In all instances, these programs were designed to meet "shortages" generated in large measure by the spectacular expansion in the magnitude and scope of the Nation's research effort and the Cold War competition. Through these target programs we have sought to increase the supply of well-trained and qualified nuclear physicists, solid state physicists, biochemists, virologists -- in short, to recruit young people for graduate training in specific fields and toward careers of particular relevance to the mission of the sponsoring agency.

2. We were tapping a shrinking population base. The size of the population age groups we are most concerned with for entrance into college, enrollment in graduate and professional training, and output of Ph.D.'s and M.D.'s remained relatively constant for the entire period which most of us know so well -- 1930-1960.

3. The shrinking population base was partially offset by rising educational expectations of American youth, with an increasing proportion completing high school, entering college, completing college, and entering graduate and professional training.

4. Consequently, the fellowship and training programs made their contribution through modest expansion in graduate enrollment and Ph.D. output and through strengthening academic capabilities.

5. Looking back, however, it is difficult to discern the impact of these programs in terms of any marked shifts in the proportion of Ph.D.'s awarded among broad fields. There are definite upsurges, however, for the fields of engineering and mathematics. The former reflects proportionate increases from a small numerical base; the latter mirrors a revolution in employment opportunities for mathematicians. And there have been movements within fields: chemistry down, physics up; biochemistry up, zoology down.

6. Nevertheless, the relative stability of Ph.D. output indicates the play of countervailing forces, especially as opportunities for support have proliferated. Since 1958 Federal programs such as NDEA have provided fellowship support in non-science fields. Probably more important, foundations and universities have given greater support to education in non-science fields as Federal support for graduate education in the sciences increased.

7. Over the past decade we have witnessed a transformation in the role of the Federal Government both in providing support for graduate study and in the development of superior science curricula in mathematics, physics, and biology on a national scale for use at the elementary and secondary levels.

8. In summary, the measures which Federal agencies have taken to expand the supply and improve the quality of high level manpower have

been responsive to program pressures and have been undertaken with all the accoutrements of mission orientation. These measures reflect the pragmatic character of our culture. We have done what we could -- to meet needs as we saw them, gaining support by demonstrating relevance to specific public purposes. We have not benefited from nor have we been hampered by a long-range planning perspective. Such a perspective is viable today with respect to the supply of high level manpower over the next decade. We have the capability to predict crucial elements of the supply situation with reasonable assurance. The clear prospect of the fundamental change in the supply situation calls for a fresh look ahead, unimpeded by the mechanisms, concepts, procedures, and shibboleths of yesterday.

Looking Ahead

A population explosion in the critical age groups will be the most potent force influencing the supply of high level manpower over the next decade. Between 1960 and 1970, the number of persons age 15-29 will increase by 15.7 million over the 1930-1960 average. This tremendous increment in the population base for higher education comes after a long period of stability and even decline. The drastic change in the demographic situation offers new opportunities for those concerned with the development of national manpower policies and programs. However, the tidal wave of freshmen entering college next Fall and the cohorts behind them won't reach graduate or professional schools for a few years yet. In my view, existing manpower programs should be reexamined critically with an eye to strategic rather than saturation support.

Anticipated Areas of Strategic Emphasis

In keeping with our egalitarian creed, our first task is to enlarge educational opportunities for talented youth. The doors are now open for virtually all qualified college graduates to enter graduate training. Economic and other barriers may deny such opportunities to aspiring youth knocking on the doors of undergraduate schools or professional schools. May I note in passing that, over the long run, millions of young Negroes constitute the largest hitherto untapped reservoir of talent for the predominantly male professions of engineering and medicine.

Increased numbers will necessitate greater selectivity in admission to college and graduate study. Many implications flow from a more rigorous selection process: (1) limited spaces in prestige private schools has raised the quality of undergraduates in State universities; (2) limited spaces for entrance into college is apt to increase the quantity and quality of students in technical institutes; (3) looking ahead, more rigorous selection for admission to graduate study should significantly diminish the attrition rate; the one Ph.D. per every 10 first-year graduate students should move in the direction of 9 out of 10 -- the current M.D. ratio. In medicine the profession regards the loss of 1 out of 10 as alarming because of the rigorous selection process governing admission.

Both of these developments -- enlargement of opportunity and greater selectivity -- lead naturally to the area of greatest strategic emphasis -- quality of education. In the decade past, we have concentrated upon assuring adequate numbers. In the decade ahead, population dynamics should assure quantity; we must concentrate upon improving the quality of education at all levels for all qualified youth in all parts of the country.

I do not imply that the emphasis upon quality is new; it is more critical. It necessitates education and training of the greatest possible depth and rigor up through doctoral and postdoctoral levels. The broader and the deeper a man's education, the greater will be his adaptability to work on problems not now visualized.

Even while we emphasize flexibility in training tomorrow's scientific and professional manpower, we face mounting needs for a new brand of continuing education. The accelerated pace of technological change, the horrendous accumulation of information, and the revolutions in instrumentation, automation, and communication point toward the need to develop more adequate mechanisms for learning-through-life.

Lurking behind continuing education is the necessity to facilitate job readjustment. Looking ahead, we can anticipate -- although we can't predict when, where, and how -- changes in the magnitude and character of defense and space expenditures, changes in the mission and operation of major research installations, launching large-scale programs responsive to the needs and opportunities generated by arms control or -- if I may be wishful -- the control of environmental hazards. We can anticipate the necessity of organized and institutionalized programs to facilitate job readjustment. This means we must develop sensitive procedures for monitoring the flow of scientific and professional manpower. Through sampling techniques we should be able to isolate the significant flows, alerting us to potential problems of job readjustment.

The Short-Run

Until now, I have been talking about the next ten years. But any short-run expansion of high-level manpower resources depends upon (1) a reorientation of career patterns for women and (2) reduction in attrition of qualified graduate students due to non-academic causes.

A reorientation of career patterns for women who begin graduate study could easily enlarge Ph.D. output by 10 percent in many fields. Women now represent 10-15 percent of Ph.D. output in the biological sciences; until recently we didn't realize that women account for 25-30 percent of first-year graduate enrollment in these fields. There are two points of leverage: (1) the values of American women (and men)--see excellent, provocative discussion by Dr. Alice Rossi in current issue of Daedalus and (2) imaginative programs within universities to cope with institutional impediments.

Obviously, any sizeable reduction in the attrition of qualified graduate students would substantially enlarge the manpower pool. The key problem here is selectivity to assure that those aided have the capability and the desire to complete graduate education.

Science Education to Facilitate More Informed Participation of Citizens in Society

Looking ahead, it seems reasonable to anticipate that a steadily widening range of personal and social choices will involve scientific considerations. This argues strongly for the incorporation of science in a meaningful way into the liberal arts curriculum. Through this experience, I believe the liberally educated person and responsible citizen of tomorrow would

gain a realistic view of the nature of scientific investigation. He should come to know science not as a museum of accepted facts, but rather as a dynamic process, an intellectual skirmish at the edge of the unknown. In short, he should know what science is and how it works. Such a conception would be particularly useful when he is called upon to make value judgments where science is concerned, as in weighing the issues involved in testing nuclear devices or new drugs--major problems confronting our Congress today.

Science and Public Policy

The reverse of science and the citizen is the scientist and public policy. Looking ahead, all signs suggest that persons administering major scientific endeavors will become increasingly involved in the public policy process. In this position, the scientist must be familiar with the past; he must be able to function at the interstices of international organizations, national governments, the scientific community, the academic world, and the environs of industry. For those who aspire to such positions, the needs are great, the opportunities abundant, the frustrations bitter, the satisfactions sweet, and the challenges unparalleled.

Summary

Since World War II, we have witnessed a transformation in the functions of educational institutions without a corresponding structural adaptation. A broad base of scientific strength has evolved through the support of research projects and mission-oriented manpower programs. Looking ahead, however, we must find ways and means of making a fundamental transition from dealing with institutions of higher learning as a means to achieve high specific and fragmented purposes to a policy perspective which views such institutions as ends in themselves. This transition is essential to provide the highest quality education to sharply rising numbers of future scientists, engineers, and professional workers in all fields. I urge you to give the matters a high priority in your discussions. Through such dialogues among many, many groups, we shall reach a viable consensus leading to the solution of the problem.

TAB 37

Remarks by Dr. J. A. Shannon

KAROLINSKA INSTITUTET

(Upon receipt of the honorary degree
of Doctor of Medicine)

I am deeply grateful for the honor you have bestowed upon me today--an honor derived from the great tradition of your institute and the high place of Sweden in medical science generally.

You have generously expressed appreciation for the support my own government has given to Swedish medical research. I cannot in conscience accept those kind words without acknowledging a profound indebtedness to Swedish science, and to the Karolinska Institute in particular, for tremendous contributions to fundamental knowledge, which all nations including mine have shared.

If I may elaborate briefly, I should like to mention the special significance of the Karolinska Institute from the viewpoint of one concerned with research organization. In essence, that significance lies in your long tradition of teaching and research in which excellence of education in science and medicine has been combined with the unflagging vitality of the individual investigator. Your maintenance of high standards during periods of impressive expansion has also been an enviable achievement.

I have often been led to reflect on certain interesting parallels between the Karolinska Institute and the National Institutes of Health. Their origins, for example, are similar in that both arose through government action at times of national crisis--Karolinska Institute during the Napoleonic wars, and NIH in response to the threat of epidemic diseases

during a period of heavy immigration. Both have been instrumental in welding science and medicine in our respective countries. And both are dedicated to a broad attack on health problems, through application of many scientific disciplines and many types of program. Although NIH proper is not a teaching institution, it serves as a training center for laboratory and clinical investigators and supports training activities.

There is one outstanding difference in our institutions--a difference of 77 years in their ages and experience. We look upon the Karolinska Institute as relatively seasoned, experienced in matters of organization and administration. The proof of your success in those respects is your illustrious history of productive operation.

Another parallel is the common experience of participating in the general scientific movement since World War II. This has been a time of great stress, social, economic, political--a time in which international tensions and crises have constantly beset us. Yet a worldwide community of medical scientists has continued to function with a high degree of productivity. Relationships between scientists have transcended the geographic, political and racial barriers. And scientific progress has been made at an unprecedented rate the world over, with benefits extending across those same barriers to people everywhere.

It is clear that the main framework and force for this development has been the scientific institutions. Other organizations and individuals have contributed; but the policies of institutions, recognizing the importance of cooperation against an enemy that knows no geographic boundaries, have kept the gates open for exchange of knowledge, skills and ideas. Thus medical science remains a truly international enterprise, and probably

the purest expression of altruism in the world today.

This is not a fact to be taken for granted. Altruism is not intrinsic to science, for history shows many examples to the contrary. It is, however, a tradition of the scientific community, and it owes its vigor to the old, established institutions and societies.

And this brings me back to my point of origin--to my personal gratitude and my institution's indebtedness. We look forward hopefully to continued cooperation with the Karolinska Institute, and to the opportunity to benefit from your experience, your standards of excellence, and your wisdom.

TAB 38

d r a f t

Dr. James A. Shannon
Dedication, Dr. Harold R. Cronin
Research Building
New York City
June 27, 1964

Your Eminence, Cardinal Spellman, honored Clergy and Sisters.....Countess Cronin.....distinguished members of the Executive Committee and Lay Advisory Board.....friends of St. Vincent's Hospital: I would like to begin by expressing my pleasure in attending these ceremonies and, on behalf of the Public Health Service, to offer the congratulations and best wishes of my colleagues. It is most heartening to all of us to see this much-needed facility, the Dr. Harold R. Cronin Building, take up a permanent place on the main line of resistance against [illegible] and death.

Dr. Harold R. Cronin was a native New Yorker who gained the highest professional distinction in some thirty years of service at St. Elizabeth's Hospital, where he was Director of Surgery for many years before his untimely death in 1958. An outstanding Catholic layman, he received many honors in recognition of his outstanding services to God and country throughout his life.

It is altogether fitting and proper that Cardinal Spellman has chosen to have this building bear Dr. Cronin's name. It will stand as a monument to his many accomplishments and attest to the generosity of his widow, Countess Lillian Cronin, whose benefactions helped so greatly in providing impetus for its creation.

This latest addition to our scientific national resources is functional, pleasing to the eye, and blends into its surroundings in a way that complements this section of the medical center and adds new dignity to the area. And I realize that it marks a long, last stride in a journey that began many years ago when St. Vincent's inaugurated its long-range expansion program.

But it represents much more than that. It is evidence that St. Vincent's is determined to maintain pace with the leaders in this nation's scientific research effort. And yet it is but the latest chapter in the proud record of achievement that St. Vincent's has written over the last one hundred and fifteen years.

At the time St. Vincent's Hospital was founded November 1, 1849, it was surely more than incidental that Archbishop Hughes chose the Feast of All Saints for the occasion. Elsewhere, in the year that would be most freely associated with the California gold rush, a number of notable events were in the making.

In that year, because of his outspoken political views, a 28-year old pathology teacher named Rudolf Virchow left the university in Berlin for the more liberal environment of Wurzburg, where he would produce his epoch-making work on cellular pathology.

And in August of 1849, a parish register in the settlement of Bond Head, Canada recorded the baptism of the ninth child of the Featherstone Oslers; they named their new son William.

Current medical literature included Thomas Addison's scholarly monograph, "The Constitutional and Local Effects of Disease of the Suprarenal Capsules," and those who read its introduction were treated to a classical description of pernicious anemia, recognized even then as the most important disease of the blood.

In America in 1849, John Kearsley Mitchell's work on malarious and epidemic fever was an important contribution to the parasitic concept of infectious diseases.

And Crawford Long, a modest country practitioner, who had "used sulphuric ether as an anesthetic in surgery on March 30th, 1842 in Georgia....." published his discovery to the world, initiating at the same time a new era in surgery and an unfortunate, long-lasting controversy.

On the distaff side, a precedent was established in 1849 when Elizabeth Blackwell was granted an M. D. degree from Geneva Medical College of Western New York and became the country's first woman doctor.

And here in New York, poor and pitifully overcrowded housing -- there are as many as 300,000 individuals per square mile -- increasing industrialization, and an utter lack of sanitation were producing an appallingly high death rate. The indigent and sick poor were consigned to the Alms House or received no treatment at all. Then Archbishop Hughes, Father Starr, and Mother Angela of the Sisters of Charity of St. Vincent de Paul decided to start a hospital for these people. It was the first charity hospital in New York depending on voluntary contributions and, from the very beginning, made no stipulations as to race, creed, or color for admission.

They rented a small private brick house on East Thirteenth street for $900 per year and outfitted it to accomodate 30 bed patients. St. Vincent's, as Dr. George Reilley Stuart noted in this charming historical sketch, opened its doors "without any assured, much less adequate source of income, without any trained nurses," and without utilities except of the crudest nature. Despite these primitive conditions, the hospital proved an immediate haven for the poorly-assimilated immigrants who crowded the city.

Expansion began early at St. Vincent's. The typhus epidemic of 1852 led to the acquisition of an adjoining house and an increase to 70 beds. By 1856 larger quarters were necessary and a building on the site of the Eleventh street hospital was rented. A private pavilion on Twelfth street followed in 1862, doubling bed capacity to 140. Rising expenses were met from financial support obtained from the Diocese,

from charitable bequests, and by affording proper accomodations to patients who were able to pay the sum of $3 per week.

The Hospital was incorporated as the St. Vincent's Hospital of the City of New York in 1870, after operating for thirteen years under a special charter granted them as a charitable institution. Tearing down of old buildings, consolidation of those remaining, and construction of new buildings continued apace and, when St. Vincent's observed its Golden Anniversary in 1899, it was well on its way to its present status as the largest church-affiliated hospital in the nation.

While its outward appearance changed only slightly over the next several decades, St. Vincent's revolutionized its internal operation. New Divisions, Departments and Specialty Services proliferated and ancillary facilities were expanded. In the late 30's, when New York Hospital left the ~~metropolitan~~ downtown scene, a large community was left almost entirely dependent on St. Vincent's for hospital service. Utilizing all the resources at its command, the hospital sustained the impact of this service increment.

But the greatest period of growth was still ahead. During the last quarter of a century, a carefully-planned building program that included eleven major hospital projects has been undertaken and completed, the latest project being this new research building we dedicate today.

Today St. Vincent's displays imposing credentials and enjoys an enviable reputation. Its renown as a teaching hospital enables it to fill its quota of interns each year through the National Intern Matching Program, while more than 100 resident physicians are seeking board certification here in approved specialty educational programs. Its Hospital School of Nursing has 500 students preparing for professional nursing careers and there are students from a dozen universities studying in nine paramedical professions ranging from administration to social service. To this panaroma, the new Dr. Harold R. Cronin Research Building will add a completely new dimension.

Not too many years ago, the construction of a separate scientific research and health facilities building such as this would have been considered hazardous. But as biomedical research quickened its pace, additional research space and modern equipment became imperatives for its continuing expansion. And, whereas in some cases it is possible to expand existing facilities by remodeling or renovation, more and more situations indicate that the most practical and economical solution build entirely new facilities, thus efficiently integrating the latest technology and instrumentation into design and construction.

While this fortunate situation obtains today, its origin is quite recent. Many of us recall that in 1956, when Congress was redefining the role of the Federal government in support of medical research, many witnesses testified that while the preceding decade had seen a large increase in funds for research, commensurate support of the facilities in which the research endeavor was maintained had not been available.

Simultaneously, after much provocative and challenging testimony from leaders of the medical and health-related professions, Congress delineated the dual function of Federal support for such research: (1) to carry its share of the responsibility for assuring that our national resources for medical research are fully and effectively utilized; and (2) to take appropriate steps to increase our medical research potential so that progress against disease is never impeded by acute shortages of trained manpower and modern research facilities.

Thus, the Health Research Facilities Program became law, foreshadowing the relationship that would evolve between the National Institutes of Health and St. Vincent's Hospital and many other medical research institutions throughout the country.

Mr. Denholm Jacobs, then associate director of the Massachusetts Eye and Ear Infirmary, clearly exposed the crux of the research facilities dilemma in testimony before a Congressional committee (1956), when he stated that "one can have the most pressing problems to solve, gifted men ready and willing to devote their lives to the solution, and ample funds to support the work, but without the space, without the laboratories, the special equipment, and other necessary facilities, there can be no research."

This is the rationale behind the Dr. Harold R. Cronin Research Building. As a large teaching medical center, St. Vincent's is uniquely equipped to couple pure research with the study of its application to man. Space will be available in this new building for the conduct of dozens of research projects in such vital fields as cancer, Hodgkin's disease, liver, heart disease and allergy. There is a pool of talented investigators available. No insuperable financial problems for the support of research intervene.

In brief, the first prerequisites for research being present, only adequate laboratories were needed, and that lack has been satisfied here by the provision of 100 fully-equipped scientific laboratories.

A generous and public-spirited citzenry has aided in implementing the will of those who direct St. Vincent's affairs to advance a scientific effort that will now bring a wide range of skills to bear against disease problems common to man. Because of their response, the constructive imagination and experimental abilities of scientists from many disciplines, acting with a singular sense of mission, will be firmly committed here to a common cause.

There is every indication that where so many dedicated persons are [illegible]d to contribute so much to that common cause, their eagerness, their intelligence, and their inspiration will, in the years ahead, enable them to help decrease our fallibility and materially lessen the inroads of disease and death.

Congratulations are in order for all whose efforts helped in the creation of this ~~building~~. I prefer the term "creation" because it reminds of Gilbert K. Chesterton's discussion of construction and creation. Chesterton said that "The whole difference between construction and creation is that a thing constructed can only be loved after it has been constructed; but a thing created is loved even before it exists."

Surely this building belongs in the second category. It is not difficult to see reflected here that love of humanity that strengthened the resolve of Archbishop Hughes and his associates those many years ago when they undertook to "do it for one of these, the least of my brethren." Nor should it be difficult to see reflected here the kind of love on which those who follow in St. Vincent de Paul's footsteps base their very existence, since it has so abundantly enriched their capacity for service to their fellow man.

Your Eminence, Cardinal Spellman, I salute you and the Catholic Charities of the Archdiocese of New York for having provided here the rich moral soil from which great crusades spring.....and I predict many years of fruitful service ahead for the Dr. Harold R. Cronin Research Building and St. Vincent's Hospital.

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TAB 39

8/11/64

Joseph Jay Bunim, Clinical Director of the National Institute of Arthritis and Metabolic Diseases, died before attaining his sixties. His passing has taken from us a personality in the first rank of those who dedicate themselves to research in the medical sciences.

I had seen him only a day or so previously, looking fit and gay and looking forward to his vacation which was to have been at this very time we are here honoring his memory. The news of his death was an added shock because with his bounce and energy, his quick walk, his expressive features, and his soft, gentle voice, he embodied a seemingly indestructible youthfulness.

Too he was a source of energy, the driving force behind many projects and many programs. It seems difficult in retrospect to conceive that his many enterprises were originated by a single person. He radiated power and energy which set many men and events in motion.

8/11
Copy to Mrs Bunim
cc Bill Carrigan

Those who had the privilege of working with him will remember him always. It was not easy to work with him; his standards were high. But instinctively one felt that his demands were always inspired by what was needed. And his demands upon others never exceeded those which he made upon himself.

In his short span of life he published more than 100 papers dealing with rheumatology. Among these were reports of his studies which ranged from the pathology and biochemistry of arthritis, to related topics in immunology and bacteriology. He wrote monographs, was founder and editor of the Bulletin on Rheumatic Diseases, and was an editor and editorial board member of many, many other journals, reviews, and transactions.

Joe was unafraid; he stood by his beliefs, defending what was unpopular and attacking what was approved. The discovery of the remarkable anti-inflammatory effects of the steroid hormone cortisone in 1948 opened a new era in the treatment of rheumatoid arthritis.

It was soon found, however, that along with beneficial effects, cortisone and hydrocortisone also produced many undesirable side effects. Opinion turned against these agents, but Dr. Bunim held that cortisone or its derivatives might still prove useful. This hope that the beneficial effects could be separated from undesirable side effects in treatment was realized in 1954 when Joe introduced into clinical medicine the first effective anti-rheumatic synthetic corticosteroid drug, prednisone and prednisolone.

Joe was tireless, and could often be found with pen in hand, immersed in writing about his research. Wherever one looks in his field, he has left his mark. He developed the Bentonite Flocculation Test for rheumatoid arthritis, a simple, quick and effective method to detect this disease. He was also a pioneer in the use of penicillin for the treatment of rheumatic fever.

Like all mortals, he loved success. But he did not lose himself in materialistic glory or pleasure. His success was of another kind. He came to the then new Institute of Arthritis and Metabolic Diseases in 1952, leaving New York University which offered him many more advantages.

He was imbued with a profound feeling and enthusiasm for research. He organized and guided the clinical research during the early years of the Institute, and he lived to enjoy the wide and excellent reputation the Institute has received.

Joe was a man of great personal charm, endowed with the gift of clear and systematic exposition. His talents were unique in that he was gifted both in the domain of original research, and in the compilation and exposition of knowledge. He always had the genius to observe things in a detached way ~~and from a distance~~, and could immediately separate the important from the not-so important. He taught medicine, and was associated with many universities and hospitals in Washington, Baltimore and New York. He wore many hats, used many pens. He worked hard to form a close working liaison among the Institute, the American Rheumatism Association, an organization of physicians dedicated to rheumatic disease research, and the Arthritis and Rheumatism Foundation, a voluntary agency. At one time he was president of the American Rheumatism Association.

For Joseph Bunim, there was no politics or ideology in suffering from disease. He believed that men are linked by common pain and suffering, and linked also by the common joy of conquering disease and disability. His deep convictions led him to organize, two years ago, an extensive symposium on rheumatic diseases between American and Russian scientists. And last spring, he headed a group of leading American rheumatologists who visited research and clinical centers in the Soviet Union. His work in the exchange of international medical information brought him much praise and many honors. Only last year, he was personally appointed by the Director-General of the World Health Organization to its expert panel on chronic degenerative diseases. In addition, he was chairman of the First International Conference on Population Studies in the Rheumatic Diseases. At the time of his passing, he was chairman of the planning committee for a third such conference.

His selection and training of clinical associates--in whom he was sincerely interested and to whom he was a source of inspiration--

paid off handsomely. Many of these young men have become integral parts of our leading medical schools engaged in arthritis and other research, and teaching.

Joe was available to all. He always had time to chat with secretaries, elevator operators, biochemists, janitors--anyone who troubled him with vague complaints of arthritis. His patients on the wards loved and respected him. From Joe to his patients came an unceasing stream of encouragement, unending patience, and a monumental understanding. In spite of his dedication to research, he never lost his unique ability to communicate with and understand the patient.

All his efforts were predicated on and motivated by humanitarian reasons. For Joe believed that the very first thing that cannot be denied is the right of man to live; to live without suffering, without fear of disease, and to live in health.

Our heartfelt sympathies are extended to his wife, Miriam, his children, Lesley, Betty and Michael, and his sister and brothers. As a husband, father, brother and friend, he was in essence the same warm, loving, tender, devoted man.

Joseph Bunim will be missed as a scientist and physician. Especially will he be missed as a close companion and a sympathetic friend. He was admired and liked by everyone who knew him, and he responded fully.

I have known him since 1931. I shall personally always remember him as a warm, loving friend to whom I could come for a chat, for advice, or for some favor. The humanity in him made it a pleasure, and not merely a relief, to receive whatever he so wholeheartedly gave. He received graciously, and never forgot favors, no matter how small or how large. We who knew and loved him shall miss him for the rest of our lives.

TAB 40

Research Associates #2

First thing about NIH clearly conditioned its ability to do its job, develop its program, must realize those operations involve expenditures about _____ million dollars, has broad impact on academic world, educationally as well as research. NIH quite far removed from policy maing level. Because we have a mixed up department. PHS is a constituent of the Department, NIH a part of that and our dealings with heirarchy within Department take place in the absence of technical competence on the level of . Operate in a never-never land administratives. Run into quite serious frustrations at times. It is further difficult, difficulty are further encountered by the fact of total PHS annual budgets which is for nine NIH institutes somewhat more than a million dollars develops rivalry between myself and bureaus. Those of you who work out here will become increasingly aware of rivalry. Those who joined DRG serving NIH and other bureaus will be in good position to see this type of rivalry. But it becomes particularly important far removal from the point of policy development when one realizes that basically authority under which PHS operates is quite inadequate. Basically have three authorities one to support research by grants that are made subsequent to recommendations by Advisory Councils, support fellowships and to train scientists. Generally speaking the individual institutes operate in categorical frame of reference indicate general area of responsibility. In this operation have very complex budget, about 10 appropriations, about 8 activities in this appropriation and in contrast to DoD/operates which on single line item, operate ours on about 80 line items. Much of difficulty run into is a consequence of position of NIH in legislative base. Try each year to modify legislative base.

The thing those of you who are here quite recently probably dont realise that if you go over the years from beginning of the NIH, which was the late 20's to the present time, it has had basically only two points, I would say three points of major growth and divergencies. In 1938 the Cancer Institute was superimposed upon what otherwise had been a discipline oriented . Don't recall what budget was in 1930, probably 4 or 5 hundred thousand dollars, one building downdown, small research institute, fully contained within the building with two field operations, one in the south _____ another the Rocky Mountain Laboratory concerned with rocky mountain spotted fever. Those of you who joined PHS appreciate that the NIH during the first three decades were as they are today one of the outstanding scientific backgrounds of the nation. Many of the leaders derive their basic competence from staff participation and we don't ordinarily think of such people ---------- ---------- examples of the younger people who had their first experience with this very early concern. I make a point of that because the big decision in establishment of the Cancer institute in 1938 posed a very serious problem, whether or not it was possible to grow at the rate of speed which seemed indicated. I think that thanks to the leadership of many individualists the basic on the part of the staff always has been done with the operation in pretty good ---------- is as good now as it every was. But the NIH you see now in 1948 is foreshadowed by the establishment of Cancer Institute in 1938 because basic guidelines was built into the legislative base of the Cancer Institute. It was established in parallel with NIH not a part of it although generally administered by the Director of NIH. Had statutory authority to employ, ability to make grants, to support fellowships and to set up National Advisory Cancer Council

and the whole operation you see today.

Interesting thing as you think back about it, time of the establishiment of NCI realize this represents a striking departure from the medical _____ of the day. Long before infectious diseases causing disability and death were conquered. ----------I was director of the research service of the _)_____ memorial hospital in New York City that was planned in 1936-37 and built in 1938-39, occupied in 1940. First chronic disease hospital in the country. Establishment of institute for chronic illness is to realize foresight of people who plannedit. Cancer at that ~~xxx~~ time was grouped with heart disease and stroke. In the day of my hospital experience this is the type of medical problem that went to the back room and was moved out to chronic hospital as soon as possible, no interest. Cancer Institute was an important ~~xxxxxxxx~~ entity, forefunner in 1948 for establishment of Heart, Dental and Mental Health Institutes Mental Health underwent transformation by conversion of Division of Mental Hygiene downtown. ----------

All of this took place within about 10 years of the establishment of first effective antibacterial drug. And within 8 years of the establishment of the Division of Chronic Disease Hospital in this country. This rate of change of attitude is one of the basic consequences of conquest of infectious diseases as the cause of death in this country. Through advances of ---------- which tended in a very broad wa to shift the spotlight from acute to chronic. Program speculation ---------- ---------- up until that time support during the war ------

Federal Government had been concerned with establishing and ~~xx~~ conduct of ---------- were in parallel with universities. Universities did not receive any form of support from the Federal Government. Intersting to know that during 1936-37-38 some of the outstanding scientists in this country were supported ---------- individuals maintained active science by somebody's foresight at that time. The beginning of modern NIH goes back to the establishment of the Cancer Institute in 1938 with the World War II advances in medical science and public decision for Federal Government aid. Role in support of science all happened when medical schools and universities had ~~xxxx~~ lost a good part of the support fro other sources. Incidental to these happenings was the training through the GI bill. 1938-48, 10 years represented tremendous scientific advances and this was the change in orientation of Federal Government toward science ~~xxx~~ because of the opportunity and because of appreciation for absence of Federal intervention.

Subsequent 15 years characterized by ---------- we have a series of categorical institutes, we have a series of institutes and divisions that take a somewhat different look at support field. Biological Standards is a control function, facilities and resources precisely what it says it is. DGMS supports broadly those things that must be done on a centralized bas but has relevance to all categorical activities. Child Health looks _____ as it grows. _____ makes a reasonably good story and in simplified fashion one agrees with the sense of categorical organization very logically put together. Close overlaps in function, Child health with NIMH. Always seemed basic framework for research that categorical oriented is perhaps most natural, supported by Congress, ----------

Progress can be related to eventual end use of knowledge and in this way although a very broad ~~xx~~ fundamental base must be constituted nevertheless is constituted in a purposeful and meaningful way. ---------- NSF has not faired nearly so well as we. They support basic science or training in basic science and doing basic science, nobody sure what basic science is.

Looking at individual institutes one finds quite sharp differences one compared to another. Typical institute of NIH. Think I would say simplified organization. Like to talk about constitution of institutes. Office of Institute Director ~~n~~ responsible for total planning. Responsible to Director of NIH but also acts with National Advisory Council ~~xxxxxxxxxxxx~~ not responsible to Director NIH but to SG. Statutes say no grant can be made save on approval of National Advisory Council. SG may choose not to pay but can not pay in absence of such approval. We have always add will have friction between office of Institute Director and his Council. One is always going to be causing trouble. The source of trouble here is while National Advisory Council has its role spelled out within the law, members are prone not only to serve in an advisory but to serve in ~~xxxx~~ capacity to take charge of determined programs. This arises if Institute is not careful to maintain Council in a state of understanding of totality of the program even though they are being asked to advise specifically only on a part of it. Relationship is a difficult one. They should be aware of what goes on in intramural research area but should not be asked to advise. Feel in this type of relationship for very knowledgeable people that advice should be of a purely technical nature and should relate to the mission not of the Institute of of that part of the Institute's mission ------- responsibility intramuarl program more as a protective device about 10years ago,set up a

group of scientific counselors concerned only with direct operation. Advise Institute Director but consults more generally with scientific director of the Institute and Dr. Mider than with the Institute Director. Although set up as technical advice quite frankly this was set up ϕ in response to ---------- in the early 50's Dr. _____ at Bureau of Standards resigned because unwilling to make a favorable report on _----------. This resulted in investigation by NAS ---------- This was where brute force of politics went ahead of knowledge with judgement of scientist and in absence of some ---------- could have been no resolution. Federal Government could have lost service of very top science administrators.

Confrey: Asked question re members of Board of Scientific Councilors

Shannon: All are from outside. Scientists selected by us within the academic community who can help us in times of stress. Point of fact, however, they have been hired as a ---------- group that are most helpful in giving advice to our senior lab chiefs and in creating an environment where NIH direct operation is better understood by academic group.----- One of the problems having no responsibility to anybody except within the line of administrative supervision Federal scientists leads protected existence as long as satisfied with what he has. Civil Servant who is hard to fire, has a very secure position. In some of the old line agencies over the years have last their bright people, the scientific activity has been recent. ----------

We feel this is general education to the academic community. Helps us place our people, helps to recruit their bright youngsters and gains broad academic acceptance.----------The main difference between Institute ---------- ---------- relates to how the programs are handled. This is division of program by mechanick of the support process-----extramural research or training

grant research for laboratory studies, etc. ----------This is the way science is involved at the NIH although this is the simplest way to develop excellence on a broad base and during a period of rapid growth. Less concerned with the substance of research than that the quality be high and the numbers be substantial. Using consensus reached by scientific community of what is important. If you have broad support you will get fairly good distribution across all sciences. From period of 1955-63 this organization was fairly well represented. In 1955 when I succeeded Sebrell $97 million.----------
------During past 9 years budget has increased 10-fold. Type of growth talking about. If one had tried to program that amount specifically one could not have----------if you did program large segments. If the individual projects fill out in proportion to scientific consensus of what was important this is reflected in grant applications. Broad growth, 1955-63. Beginning in 1963 or in 1960 certain quite broad program objectives began to crystalize. Cancer chemotherapy, 1959-60, some of the drug studies, cholesterol in the HeartInstitute, 1959-61. Exa,ples of beginning developments that wee quite pointed in that they had specific objectives within categorical programs. When one started such a program could no longer administer by mechanisms but by program objectives. As this has evolved some of the institutes completely dominated by program objectives rather than by ----------. NCI now have a _----------
but dollar emphasis is on cancer chemotherapy, carcinogenisis----------.
Have a scientific director who is less concerned with an effort ----goes on whether extramural or intramural there is broad representation to all the areas to assure that studies are being cared for.----------

Budget supplement worked out for the Senate, about 10 million dollars. That will be spent in 6 boxes. Program development by Institute Director with advice of Associate Director. Another example, Child Health is attempting to develop its total program in terms of program objectives and the program leaders and areas will have specific responsibility for grant and training as well as their own research. I don't think it is going to work. Reason why I don't think it will work is that it at a time when competition for dollars you have very generous people from outside and the man in the middle has to decide whether to support his own work or work of another. Puts people in the very uncomfortable position. Any aggregate top scientists of the U.S. determined to support all science in the U.S. politically will be in trouble if budgets get tight.

I think what is going to happen while this is highly stylized set-up will develop into another type of set-up where there will be another series of boxes here that will represent staff groups, they will be substantially oriented toward program, where people who are quite competent to handle mechanims once the program decisions have been made.-------I point out right now not institute has such groups, although they are using people in this general position.----------You really see institutes in transition as far as insitute is concerned. Future remains to be worked out.

ODOROFF - asked question about these new groups.

SHANNON: Present planning of evaluation function will be expanded but is presently data dollecting and analyzing group. Groups I am talking about now going to have top----------.

Medical research as proportion of all research and development. This chart was prepared to anwer the problem commonly stated by reporters, congress, etc., and from smaller competitors in the basic sciences that there has been a tremendous explosion in the support of medical science, past years budget has increased at fantastic rate, field must be saturated, any further expansion is not necessary. Medical sciences have simply participated in the general increase in the support of science. Figure in 1950 about 5%. Figure now is somewhere about 67%. As compared to all research and development medical science has been increasing but may be is only 2 percent. Contained within it as compared to the whole 67%--------- important lesson this chart tells is that since 1950 this country has undergone technological evolution. All sciences increasing rapidly and medical science as well. --------
This chart is a simplification. Going from $161 million to $1.5 billion the science technition ---------and the medical sciences has very much higher scientific content than obtains in remainder of the area. Consider all research and development programs of these dollars go for airplanes, missiles space, things of that sort. Research and development in general is an engineering paradise rather than scientific paradise.----------
Very pertinent to the actual situation when the taxpayer decides to spend a dollar how does he spend it. Lesson drawn from that. ----------
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Second thing to point out in relation to all research and development, Federal Government has had whole new areas to its sphere of activities. Space budget is now billion. One opened whole new area in active support of oceanography ----------Medical science has a fairly coherent group of related activities. Has grown without being off into other things.----------

As pointed out in --------- of who spends the money. All Federal R&D educational institutions only spend 12 cents on a dollar. Medical and health research expenditures at educationa institutions and other nonprofit institutions now spend 60 cents on the follar. This emphasizes relationship that expenditure on medical and health related dollars has profound impact on our educational institutes whereas expenditures of other research and developments funds more heavily involved in industrial plants. Comes time in development of a program however categorically oriented if categories are numerous enough as to cover all sciences relative one has to be concerned about the health and vigor of institute within which this research takes place. incumbent upon the agency that supports a major share of this activity to be concerned about terms and conditions of grants so that while cannot directly support, generally support aims of the institution, develop certain programs that are directly supportive of university programs as such. ----------

Emphasized one takes a look at development of research since 1940 ------ 1931 had not too heavy a teaching load ----------

There were only two foundations that generally support research, Rockefeller Carnegie did a little and then there were some very small foundations

Good deal of research----------

Research was done not a s a major part of ones vocation but more or less as an avocation and as essential part of job as professor. ----------

Another thing to note in 1940, that $3 million came from Federal Government basically all was spend in laboratories of Federal Government.

General fear has been stated by many -------we are tying up private support of research. This is commonly stated by the foundations more particularly those who seek help. Private support of science has increased

tremendously,in last 3 or 4 years has plateaued out. Likely to continue at that level and only expand as population expands. ----------

that the type of persons who will support private ----------

nonfederal support is very important to science. This is money that precludes the Federal Government from pre-empting and the fact of determining what shall be supported and what shall not be supported. ----------

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Although ---------- program is not large, still sufficiently large as to prevent large range program from covering the quite pedestrian----------

CONFREY: If nonfederal portion does plateau will this act as a brake on the growth of Federal ~~support~~ institutes.

SHANNON: No.----------

ODOROFF: IN talking of control of science, suggesting this depended upon_____

SHANNON: Seriously considered about ---------- of investigator work going around the country involving organ transplantation. At the present time much of it is scientifically not very sound. I think we go before our Councils and convince them to declare a moreatorium for a time without program development in that field. We chose to accelerate our own portion of it and indicate to a number of people our concern about the development. At the end of the year have not made any impact on understanding of the fundamental process and if snowball conditions deciding we must curtail the growth of this as long as there is a large segment of dollars we can take advantage of this.

Everybody expressing concern about problems of population explosion. Certain activities in that area are highly controversial. Area which is much more suited for a private foundation to undertake than a government agency. Our unwillingness to undertake certain aspects in no way holds back the field. Don't minimize the importance of the ability of staff groups to condition the advisory Council, don't minimize very important fact that in the final analysis and advice is advice and SG need not take this advice so that these considerations make that very important.

If you are called upon to discuss some of the generalities of the program you may find these charts useful. Bill will get them for you----------
NIH funds as portion of nation's support of medical research.
Interesting thing is that about 3 or 4 years ago with much ---------budget NIH supported ----------total Federal support of research about 60% as----------to 63 NIH was about 45%. Other federal comes from increases in support of research by VA, AEC, development of Space agency program in biology and medicine, NSF portion hasn't changed a great deal, they have about $10 million.----------Middle 1950's Federal contribution averaged over 50% and NIH dominant then. BSS has taken over environmental health and they are included in other Federal. Reduces 45% to about 39%.

Trends in federal support of research at colleges and universities.
If you take all funds fed into colleges and universities in support of all research you find NIH supplies 1/3 of total funds. Includes all universities but separates thos research institutions as the jet propulsion laboratory etc. ---------- NSF 1 % 11 years later 12%.----------
Space now has 8% of 946 million in 1962. -------By way other Federal agencies

-----one a big segment there has some impact but not such a broad impact ------environmental health hits about 1/3 to 1/4 and the other federal agencies. ----------Viewed this way and taking a hard look at the academic picture it seems these programs have tremendous impact.

Think we have not really been in these budgets up to the present time it is less important to know that NIH contributes 33 percent of all research dollars to institutions ~~which~~ but would be nice to know what NIH contributes in aggregate because it has---------- 250 million trining, 50 million construction, large part of it going to universities. Then presenting a wholly new program, Office of Education. OE budget for 1965 is $1.6 billion going into the educational process. Began to see magnitude of Federal expenditures ~~for direct impact~~ have direct impact on higher education and ~~its~~ it is more than conventionally thought. Talking to OST last Friday told them to ask Murtaugh to meet with OE early this fall ask them to come to Institute Directors meeting. President's Science Advisory Committee would be equally concerned. ---------- Have to realize that through NDEA extension---------- Wihtout fanfare most people don't appreciate the extraordinary investment we have. ----------If you add support of construction facilities and training and add the office of education then begin to get the true picture of the Federal support of science as opposed to Federal support of education. This is important to realize because Federal Government is wrongly accused of supporting only medical research and not the educational process. ---------to say that 1.6 billion is not all spent on higher education, spent on grammer school, high school education, etc. Point is that the

educational process in the aggregate then it is not true that Federal Government is only interested in research in education.

NIH growth and functions

Modern NIH emerged as a proper World War II phenomena. The big break came in December of 1956 when Folsom decided medical sciences were not adequately supported. Felt that rate of expansion in medical research was limited by research capabilities of the Nation rather than dollars for their support and as a result expanded not only support of science but training programs and construction programs. Other decisions in period of 1962, 1959-60, when decided that the time was ripe that a very broad base developed to spend more time directly in relation to the need of institutional needs. This lead eventually to General Research Support Grants. These took place at a rate greater percentagewise than for research. Diversion of these funds so that development of research in 1964 amounted to 28% of our total and support of research amounted to 68%. Roughly 30 ----- 70% for support of current activity. Our guess is that that 30% will probably rise to perhaps 40% in the course of the next 3 or 4 years, primarily to a construction program, further development of general research and training, grant program and for expansion of training and fellowship programs. Will either have to be developed or subtracted from the present status. With a final analysis we have come through a fairly rapidly evolving structure with program emphasis changing shape in the 30's again in the 40's, in the 50's and less rapidly now but in the 60's. I think quite sharply in the 60's where for the first time program objectives begin to determine the growth rather than-------

QUESTION: Like your advice on program project as contrasted to individual projects.

SHANNON: Will probably develop much as they are developing now. Part of the evolution of our mechanisms is the more pointed development of whole research institutions and universities---------projects not as a program---- one or a group of scientist elect to pursue a line of inquiry that may be defined narrowly or broadly and are given support to continue it and in effect carry out their work. Change in grant procedure during the coming years has----------

where it possible to establish 45 or 6 research institutes not to develop from our own institute for research might have a very profound impact on science. ----------focusses on the dental science as a suitable area for grant study one begins to introduce good scientists instead of trying to make a technical oriented school ---------- elected to pursue programs in mental retardation, child health and human development, aging. These are broad areas can not be encompassed in the conventional program. Scientists who are capable of participating in the broad programs are not contained in individual departments not even ---------schools. Have to go to university department for some of the biologics, mix them with a medically oriented, disease oriented people, have no conventional slot to put this in so best thing to do is to develop as a thing in itself. Major trend in coming 10 years not be program projects but rather new developments of total institutions that parallel with professional school or university.

CONFREY: This has been a year of scrutiny, Roberts, Daddario, Wooldridge Elliott Committee, etc. How will the agency come out of this:

SHANNON: Wooldridge Committee----------Commission on Heart Disease, Cancer and Stroke will give a good push. ----------

CONFREY: Could we begin to think of reducing complexity and size of our grants manual and procedures?

SHANNON: Don't think time is right. ----------
I think having the hearings and having certain things called to our attention much of what we are doing is not forced on us by the committee, forced on us by a combination of circumstances----------
GAO inquiry ----------requirements are we should have a very simple assurance that the money is being spent----------
requirements are basic----------basically a grant is made and reviewed because the main purpose is to do a specific thing, give him money to do it. How money is spent. Many individual scientists ----------
Probably our grants manual did not make essential thing clear, very simple responsibility stated in one sentence, whole grants manual relates to how one gets assurances that money is spent as planned. Asked by Congress, GAO, Bureau of Budget. Grants manual can be greatly simplified don't think responsibility can.

CONFREY: Table giving responses as to institutes which were concerned about administrative rate table------asked to rate agencies----NIH received a rate of 19% difficulty, 4% NSF In several areas we are more complex.

QUESTION re changover in the institutes.

SHANNON: Organization will be more in a program line force of research grant training, etc. As institutes move in this direction might be better Review of scientific might better be handled by one review body rather than for study sections, etc, all handling the same business.

Can't get away from this. I don't visualize review groups as determining any thing other than adequacy. On the other hand, I have always felt that institutions have done a bit poor job in managing training program. Some don't know what they are doing. I don't see how they can differentiate training and ----------in the way of overal review. Training grant should be as a research grant and don't see how can have good training grants unless they have aggregate analysis of what they are doing and what they are accomplishing. I don't think small staff would be adequate to do it themselves without outside experts in this area. Final analysis when program decision has been made program decision will be implemented by the budget. Final analysis is the operating budget. Almost overriding ------- once that has been determined----------

Arbitrary decisions should not be made by advisory group, should be by top staff implemented by Bureau of the Budget. ----------

In 1956, first year I was director of NIH polio problem was solved temporarily. Man in Mider's position at that time was Dr. Smadel. Very closely tied in to polio program. Essentially every outstanding virologist in the country had been involved. Asked Joe to visit them and get them to switch from polio. Within 2 or 3 year period we had captured about one half of the national foundation----------and their program was oriented towards cancer and chronic illness. Pay-off you see today. How you can modify the ¢ emergency of the field. Have to be certain of yourself if you do. I suspect

if you are really off base you wont attract the sciences. These are mechanisms available centrally to modify national effort----------

QUESTION: Re manpower problems of NIH, supply and demand of scientists terms of pay structure

SHANNON: Going to have rough sledding. In 1960 made 10 year projection of manpower requirements for biology and medicine. Figure about 39,000 on hand, shooting for about 77,000 Somebody bold enough to estimate. ---------- Thought that guess good as any other, calculated what would be manpower requirements of program level of $3 million came up to 77 thousand. One thing happened since that time. In 1960 period of rapid growth, now in middle of that period trying to remedy broad areas of need, undertaking program of selective growth rate of increase of dollares is less but manpower requirements more critical. Don't know where going to be in 1970 with this switch because over and above that switch we have two other factors. Need for professionals increasingly aware as aerospace industry of very many contract opportunities for very broad pertinence to medical research activity. How do we balance our program to set continued selective expansion of research----------
Within that general pact it would be that we could be pushing into a more critical shortage of manpower than we have at the present time and ability to compete with universities probably will continue pretty much as it has in the past. Will not have too much difficulty in recruiting the younger up to middle stage involvement but very much difficulty for top management from outside. Chances are becoming ingrown. We will have problems it is certain. Hope that we can obtain sufficient mix from outside in our senior positions and don't have to determine on internal operation exclusively.

Talked about position in past 10 years--have had enough people in middle and top grades to maintain----------

TAB 41

PANEL DISCUSSION ON PERSONNEL INTERCHANGE
BETWEEN GOVERNMENT, UNIVERSITIES, AND INDUSTRY

Every laboratory in the Federal service depends on the infusion of new blood at all levels to maintain its vitality. In a healthy organization, presumably, staff accessions essentially balance staff departures to competing organizations. There appears to be a concensus that Federal laboratories are reasonably successful in maintaining this essential balance at the junior and intermediate grade levels.

At the senior levels, however, we have ample evidence that this balance is clearly not maintained. The scientific leaders in every distinguished Federal laboratory receive occasional or frequent tempting offers from industry and universities. Inevitably some are accepted, resulting directly in leadership loss. However, Federal laboratories often find themselves unable to attract from industry and universities senior talent equal to that being spirited away. A Federal laboratory, for instance, is only very rarely able to attract a university dean or department head or senior chair holder. Equally infrequently do we attract industrial scientists of similar caliber. Unless compensating acquisition of essentially equal caliber can be attracted, this one-way traffic must result in decreasing the effectiveness of the Federal research effort.

It is not uncommon for senior Federal scientific positions to be vacant for months or years. A balanced exchange of scientific leadership between Federal and non-Federal laboratories would suggest that these extended vacancies would be found with the same frequency in the Federal service as elsewhere. We suspect, however, that they are found much more frequently in the Federal service.

As of 1962, N.S.F. studies show us that scientists are employed as follows:

Type of Employer	%	Number
Educational institutions	28%	60,319
Government organizations	21%	43,488
Industry and business	42%	90,800
Other	9%	20,333

There are no overall figures available on the shifting of scientific manpower between the various sectors of the economy. Each Federal agency which uses such employees no doubt has figures showing where they come from and where they go, and various specialized groups (e.g., N.E.A., the Engineer Manpower Commission) have made studies concerning movement of their particular type of professional members. However we are in the dark, relatively, as to numbers of scientists who change jobs, and for what reasons. This is an area which needs study and which should yield information that would help us to devise means of encouraging interchange profitable to all.

There can be little doubt that an essentially balanced interchange would be profitable, providing better utilization of existing manpower and bringing fresh points of view to bear on common problems. The Federal government in particular would benefit in that interchange would help to educate the public concerning the career service. It would point up the positive values which Federal employment offers the high-level scientist, and in turn would make use of the upper-echelon Federal scientist as an effective representative of Federal employment.

Some of the problems of such an interchange of personnel are evident. At present, salary differentials, pension plans, and conflict of interest

regulations disadvantage the Federal government. Fear of loss of able personnel is also a deterrent.

How can obstacles to a more even distribution of scientific leadership be removed? What attitudes need to be changed? What policies need to be restated to facilitate a more even flow of personnel? How would interchange of high-level scientific personnel help your organization and how would you use it? Any statistics showing movement of scientific and technical employees in or out of your organization will be useful. If you have had any experiences in exchange of personnel, share them with this discussion group. We hope that, as a result of our discussions, recommendations can be made to the Council for a course of action designed to increase the flow of scientific leadership to Federal laboratories.

TAB 42

UNITED STATES GOVERNMENT

Memorandum

U.S. CIVIL SERVICE COMMISSION

343

Subject: Review of Transcript of December 7-8 FCST-CSC Symposium

Date: December 23, 1964

In Reply Refer To: PPM:RLS:nl

Your Reference:

From: Richard L. Simpier, Member
Symposium Work Group

To: Dr. James A. Shannon
Director, National Institutes
of Health
Washington, D.C. 20014

Enclosed is a copy of the transcript covering your presentation at the December 7-8 symposium on "The Environment of the Federal Laboratory." I would appreciate it if you would review the transcript, make any changes you feel desirable, and return it to me by January 15, 1965. Corrected versions of the transcripts will make up the symposium proceedings which we plan to publish.

Enclosure

Keep Freedom in Your Future With U.S. Savings Bonds

CSC FORM 631
NOVEMBER 1961

U.S. GOVERNMENT PRINTING OFFICE: 1964—O-729-462

O.K. as corrected by WE for Dr. Shannon

PROCEEDINGS

MR. HOOPER: Could I have your attention, please, for a moment?

In this plenary session, we will go back over the activities of the morning.

I would like to say at the outset that this day and a half has passed very quickly for me, and I hope that all of you feel the same way. I think that over the course of this day and a half, all of you laboratory directors have produced enough innovations and ideas to keep the bureaucrats and administrators in Washington busy working for a long time, and maybe people won't have to move thirteen miles or more away from Washington in order to have a stable research activity, as was suggested yesterday.

The discussions ranged far and wide this morning. Of that I am sure, because I left one session in the middle of a very important pickle factory problem.

(Laughter.)

And I entered another right in the middle of the philosophy of Rousseau. So I am sure that what is said this morning will be most interesting, and it might even have something to do with research.

The first discussion was led by Dr. Shannon. Dr. Shannon has had a long association with the National Institutes of Health from the National Heart Institute, where he worked

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from 1949 to 1952, when he became the Associate Director of the National Institutes of Health, and then, since 1955, he has been the Director of N. I. H.

He has a Ph.D. and M. D. from N. Y. U., and he has got honors too numerous to mention, but they include such things as the Mendel Award from Villanova, the Public Welfare Medal of the National Academy of Sciences, and recently the Rockefell Public Service Award.

Dr. Shannon.

(Applause.)

DR. SHANNON: Thank you, Bill.

I might say that we had a most interesting discussion.

No ¶

What we tried to do was to limit ~~the area of discussion to what was considered to be~~ ourselves to the most critical issues. We had a general consensus ~~that, I am sure you will all agree,~~ that, on balance, the net effectiveness of the Federal operation, ~~whether it be~~ both in its own direct ~~operation or in~~ activities and its contract ~~program or~~ and grant program, is determined largely by the scientific excellence of the leadership of the various organizations.

And indeed, when one looked at the personnel figures on exchanges and the like, dealing with the problem of interchange of scientific personnel ~~between~~ among industry, the universities, and the Federal Government, there was pretty general

agreement that this takes place well and effectively at the junior and intermediate levels, but very poorly at the top, and that problems of general turnover rate have been well handled by the Federal pay legislation in the aggregate when one deals with the mass of employees, actually being about the same in the Federal Government as in the university or industry.

But encompassed in this large mass of peripatetic scientists are a small number of laboratory managers, directors, leaders, and what-have-you, that really determine the effectiveness of our programs; and it was thought that this would be the area around which the discussion would be used, could be best -- or this is the area where time could be more effectively spent.

And so it was limited largely to that.

The discussion developed along a variety of lines with outlines of varying degrees of difficulty in different agencies, and indeed, they are quite different so that a scientist isn't a scientist, or a scientist's opportunity depends almost as much upon his specialty in the agency within which he operates as it does upon his own inherent work.

But very quickly there came into the field the problem of salary, and I suppose that we spent about half of our time on what were the real problems, relative to salary, and that we spent about half of our time, given the present salary

schedules, ~~then what devices or what~~ techniques ~~can~~ for making the present operation most effective.

I think that the best statement about salary -- and I will mention this first and then get on with the rest -- is that there should be a broad appreciation on the part of scientists in government, and this appreciation should be transmitted through their normal channels to the Secretary's level, and certainly to the Assistant Secretaries of R and D and the Federal Council.

The scientists, in general, while ~~being~~ very glad that some light was seen in the salary situation, viewed the current legislation under which we operate as ~~being~~ incomplete in that it does not provide a solution for top scientific management.

And although we should take heart from the Congressional action, we should insist at every opportunity that ~~continuing~~ consideration be given to ~~this~~ this continuing need.

Now, it was pointed out and generally agreed that ~~except in the case of the individual,~~ this is usually a political rather than a fiscal issue. ~~Now~~ It ~~was very~~ is fiscal when one considers the individual scientists concerned. But if it ~~but that~~ were possible to obtain adequate relief in terms of top management ~~of science~~ or top scientists as such, taking each ~~one~~ on his own merits, ~~as warranted by that consideration,~~ then it would be likely that the ~~reaction of~~ industries and ~~the~~ universities would react by moving ~~be to~~

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higher, and we would be in basically the same situation as we were before.

While I am not convinced that this is the case, I think that serious consideration might be given to how our own activities and ~~our~~ grant and contract programs tend to ~~provide~~ create ~~for us~~ a type of competition that we never can effectively meet, ~~so that the first point would be that~~ If we make a solid push in this area, ~~on all fronts,~~ we ~~one~~ must consider not only our own laboratories and our own needs, but how the other ~~parts of our~~ agencies handle their activities when they face the university, ~~on the one hand,~~ or industry, ~~on the other.~~

A ~~The~~ second general point ~~in this area~~ that should that be made is we are talking about ~~a~~ surprisingly few people, ~~and~~ I had occasion this morning to use ~~the~~ figures from ~~at~~ the National Institutes of Health which ~~that~~ I know well.

We have about ~~1,200~~ 1,800 professional Ph.D.'s, ~~or~~ M. D.'s or combined degrees, of which 115 are Public Law 313 or ~~20%~~ 20%-G ~~type of~~ jobs, ~~and~~ We are ~~talking~~ referring to about 20 really ~~about twenty~~ per cent of ~~the 115 that~~ those -- say, about 25 positions that would make the difference between ~~being able to carry on~~ a totally vigorous program and ~~having to limp along~~ an inadequate operation with many very important jobs left unfilled.

So the aggregate cost in salary is not large, but the ~~aggregate~~ loss in scientific potential is substantial. And we are not ~~talking~~ speaking at this point of ~~in time, in discussing the needs for salary adjustments with~~ any massive, across-the-

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board type of salary action, ~~but~~ rather, we mean, I believe, the type of ~~salary~~ adjustment that ~~I believe that~~ Dr. Astin's panel ~~initially~~ recommended some two years ago when they first considered the problem.

~~The other area then of, given -- it is certainly reasonable that there is not going to be any prompt change in salary schedules?~~

Another major question that arose concerned the possible ~~Then what are the features~~ of our present programs ~~that can be modified~~ to make them more effective?

We have a series of quite concrete proposals that ~~we feel that we~~ should like to call to your attention:

The first is the establishment of a visiting scientist program, ~~that~~ which we were told ~~was~~ is already in ~~the works~~ progress within the Civil Service Commission.

This would permit travel to and from the job, commitment by the laboratory or by the institute, and determination of the salary level in accordance with the scientific contribution that the individual was expected to make, rather than the administrative load ~~that was~~ to be imposed upon him.

I made the point that we were fortunate in having specialized legislation of this sort, and have used it extensively, ~~and~~ I quoted figures ~~over~~ of the past five years to indicate that in the foreign field alone we have employed ~~something in excess of nine hundred people~~ more than 900 persons by such devices. ~~and found it~~ We have found this invaluable, both as ~~a recruiting device for~~ an initial step to long-term employ- authority

ment, as the initial step into long-term employment, and for shorter periods of time. and in short-term appointments.

I think that you will probably hear something about this, and I would hope that the Civil Service Commission might make available to the Standing Committee the specifics of the proposal that they are now considering, so that it could be discussed and widely disseminated.

It was the conviction of everybody in the room that this should be very vigorously supported.

It was also pointed out that it is likely that probably not enough laboratories make use of summer consultants at the senior level, and that one of the reasons, for them not making use of this again is one of the mechanics of employment, that we all are particularly under the gun in this year, evidently, is a problem that affects us all -- namely, that of and that is the problem of personnel ceilings.

The people from Goddard said that they had used the program it to obtain outstanding consultants for temporary appointment, using it both for professors and for young scientists, But they find today, however, that they cannot plan the program, nor will they be able to plan it until perhaps as late as next May, at which when time the very people that they would like to get will have made their own plans for a summer occupation.

So, that this is an area which, perhaps, might that might warrant special consideration by the Bureau of the Budget, particularly in so far as they are the ones that imposed created the personnel system,

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and Perhaps, Dr. Astin, your Committee might discuss with the Civil Service Commission and with the Bureau of the Budget some means whereby plans for the coming summer of a temporary nature can go forward.

It seemed reasonable to the group that some mechanism could be worked out, since this involves no permanent commitment to personnel nor permanent elevation of the personnel ceilings. ~~But in the absence of an ability to plan, this very important element that can be used to shore up the scientific competence of the agency is not available to them.~~

We had an interesting suggestion from the Bureau of Standards of a recruitment device that broadly involved the scientific community.

~~Assuming~~, of course, ~~that~~ the director, and through him the Department, must make the final appointment, ~~it~~ they indicated that they had been successful in mounting a program ~~by~~ in which a group of consultants not only ~~making~~ certain recommendations, but actually ~~doing~~ the recruiting.

It was pointed out that one of the important ~~offsets~~ aspects ~~of this was the growing appreciation in this particular area~~ of the program was its ~~--~~which happened to be materiel research. ~~The~~ impact on the thinking of the scientists in ~~the~~ this area ~~of~~ which their deep involvement ~~with~~ in the federal responsibility ~~that~~ normally they would be apt not to recognize. They have shown a growing

~~And~~ It was their feeling, too--, and many of us heartily

agree that this type of recruitment might well be helpful elsewhere.

In relation to this problem, it was pointed out further that in attempting to get scarce personnel with scientific and management skills, we might think in terms of segments of careers rather than total careers, and that individuals who served for as short a period of time as five years would not completely remove themselves from industry or the academic world, and they could return quite easily, yet do a substantial job that otherwise would not be done.

It was apparent in the discussion that many agencies in the executive branch of government have problems that are self-generated -- that is, generated by the agency and not by the laboratory, and we were very glad to hear that the Civil Service will hereafter pay much more attention to management devices that are utilized in running programs than to the mass of employees at the lower levels, which has been their major preoccupation in the past.

This will greatly aid the individual laboratory that has not been able to solve a problem through normal channels,

and perhaps some relief.

I might say, as a personal observation, that NIH is we are peculiarly fortunate in this regard, in that we have funding ability to support the have the funds necessary Civil Service completely in the way it manages the programs operations. Although we don't necessarily agree with the programs themselves, the operations themselves, but we do feel that they the Civil Service acts within their its limitations in a most enlightened fashion; and in the discussions that I have had, or our personnel people, or our program leaders we have had with other agencies, we find that in general the problem or the bottleneck is to be found at the agency level, rather than in the Civil Service regulations.

Now finally, then, let us say that it was agreed that interchange was good, and was essential to growth; and that there had to be a balance between an operation as a career service and an operation enlivened by the influx of blood at all levels; and that the general and intermediate levels were well taken care of now, and that while the primary bottleneck at the senior level was the dollars available for recompense, that unavailability of dollars for compensation. In this respect, we should be heartened by the moves that have taken place in the past year, but not at all be satisfied that the problem is not a large dollar one, problem, and the net gains from efficiently run programs so far outstrip the expenditure that this would be a most economical step for Mr. Johnson to foster.

Those, I think, that these are the main issues that were

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discussed.

If ~~there are~~ any other panel members ~~who~~ feel that ~~the~~ I have left out ~~are~~ important points, ~~on that, that I left out,~~ I would be very happy to have them remind me.

Thank you very much.

(Applause.)

MR. HOOPER: Thank you, Dr. Shannon.

The second discussion group dealt with professional training and development, and it was led by Dr. Weyl. Joe Weyl has had a magnificent career in the federal service. I believe -- correct me, if I am wrong, Joe -- that you have completed twenty years in the federal service this year.

DR. WEYL: Yes.

MR. HOOPER: I won't go through the step-by-step procedure, but just to say that since 1961, he has been the Deputy Chief and Chief Scientist of O. N. R.

For a while in 1962, he was asked to assume a responsibility of Assistant Director for Research, Office of the Director of Research and Engineering.

He certainly is capable in many fields. For a year, from July, 1963, through most of this year, he was wearing at least two hats that I know of:

He was, in addition to his O. N. R. responsibilities the first science advisor to A. I. D., and the science advisor to the Administrator, David Bell. And since 1958 he has been

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TAB 43

House

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Statement by Director, National Institutes of Health
Public Health Service

on

1966 Appropriation Estimates

Mr. Chairman and members of the Committee:

I have always felt it to be one of my more congenial duties to appear before this Committee to report to you on the progress of the national effort in health research, to give an account of NIH stewardship in administering Federal support for biomedical research and to outline the future needs of the program as I see them. This is the tenth occasion on which I have had this privilege and I am therefore especially mindful today of the role which this Committee has played in stimulating medical research. The tremendous growth in the scope and substance of the NIH programs during the past ten years owes much to Congressional recognition of the importance and urgency of health research.

Before proceeding further with my prepared statement, Mr. Chairman, it might be appropriate if I were to act on your suggestion and sketch out, for the benefit of the new members of this Committee, the background of the NIH programs, and their relationship both to the total national medical research effort and to the role which the Federal Government plays in its support.

[Extemporaneous description of NIH programs and their role]

I should like to talk for a few minutes about the direction in which biomedical research seems to be moving and the role which Federal support programs--and the NIH programs in particular--might most usefully play in the years immediately ahead. I should then like to discuss some of our administrative problems and comment on the salient features of the NIH budget request that is now before you.

The growth that has taken place in medical research involves much more than the increase in the size of the expenditure for its support of the number of people actively engaged in it. It has been a growth in the true biological sense of development. The medical research effort today is not merely larger than it was ten years ago, it is also more mature--in character, in outlook and in capabilities. The change that has taken place is, in fact, as significant as the transition from adolesence to adulthood.

The biomedical research community in this country is now quite clearly entering a new phase which involves dramatic changes in its concepts concerning some of the major biological and disease problems, in the substance of the investigations it undertakes, in the tools and methods which it uses and in the social and economic framework within which it works.

Biology is the most complex of the sciences and, because it involves life itself, the most difficult field for experimentation. It has therefore lagged behind the other sciences in reaching a

comparable stage of maturity. Progress along the broad frontier of science is never uniform and major advances take place, successively, in one or the other of its principal disciplines. Chemistry, for example, made tremendous strides during the 1920's and 1930's; physics was clearly the dominant science of the 1940's and 1950's. There is reason to believe--and certainly much reason to hope--that in the 1960's we have entered what may come to be called the age of biology.

New knowledge, new techniques and, which is even more important, new ideas are changing the structure of biology as a science, are amplifying the power of medicine to deal with the problems of sickness, disability and premature death, and will in the foreseeable future alter the patterns of preventive and therapeutic medicine.

These changes will require comparable changes in the collective community involvement in biomedical research, training and services of which the Federal support programs are an increasingly important feature. Scientific progress and societal support are reciprocal factors: as science progresses it makes more demands on society; as society broadens its support, science is able to progress more rapidly.

During the past ten years the NIH extramural programs have been primarily designed, on the one hand, to stimulate and support the work of individual investigators and, on the other, to build up the national capability for research. To the latter end we have been

concerned with research-training, primarily at the graduate levels; with early support for promising young investigators; with the construction and equipping of more adequate research facilities; and, in recent years, with the creation of new forms of integrated research organizations.

These efforts have been outstandingly effective. No one who has watched the development of biomedical research during the past decade can fail to be impressed by its progress. There has been rapid and steady acceleration in the expansion of research capability; in broadening the scope of attack both on basic biological questions and on disease problems; in the pace of research productivity and achievement; and in heightening the quality of the work done.

The lack of facilities and experienced research personnel is no longer the seriously limiting factor on the expansion of research that it was up to a very few years ago. Thanks in no small measure to the consistent interest of the Congress, this country now has varied and flexible means for biomedical research which, if existing programs are vigorously maintained, will continue to gain in strength and versatility. In other words, we need no longer be primarily concerned with laying the foundations for research--the main thrust of our efforts can now be devoted to mounting the comprehensive and massive attacks on disease problems and related basic research for which these foundations were designed.

This is not to say that we shall no longer be concerned with broad national needs for new resources and new facilities both for research and for training. The needs of graduate education in the biological sciences, in particular, are far from being met. We should, for example, stimulate and assist the new medical schools that are now coming into being to include in their plans adequate resources for graduate education. But, on the whole, we may now turn our attention to problems of balance and adaptability to changing opportunities. This will require us to become more selective in expanding our support programs.

The directions in which Federal support for biomedical research should move must be related to an overall national plan and purpose which, on one side, encompasses activities in the prevention, diagnosis and treatment of disease and, on the other side, includes undergraduate, graduate and professional education and the whole gamut of scientific research activities.

Within this broad context, NIH plays a dual role. By its organizational position as a bureau of the Public Health Service and the legislative language creating the various Institutes, NIH is properly described as a health organization using scientific research for the futherance of its particular health mission. At the same time, however, because of the nature of its activities and its special relationships with the academic community, NIH can also be regarded as a scientific research organization which has the

special mission of concerning itself with health problems. In its role as a health organization, NIH is an important adjunct to health service activities and, as its preoccupation with the creation of a research base recedes, it should be able to give more attention to the need to provide a better link between research results and their practical application. In its role as a scientific research organization, NIH has a significant involvement with university science departments and, as the science base of medical research broadens, NIH will inevitably be increasingly involved in the activities of a wider circle of the scientific community. These two spheres of interest are not necessarily in conflict but they do present problems of balance and seem likely, in the future, to complicate the task of effective policy and program development.

The substance of science with which medical research must be concerned has expanded to a point where the traditional clinical disciplines no longer dominate the scene. Some of the most promising and productive work is today being done in fields that sprawl across the neat categories into which academic science has long been divided. The foresight of the Congress in providing support for a very broad range of fundamental research and training relevant to the health sciences has played a large part in fostering this widening of the thrust of biomedical research.

An outstanding example of the 'new look' in medical research is the move towards the intensive study of human development--viewing man as a single complex unit and his progression from conception to death as a single consequential continuum. There is ample reason to believe that such an integrated approach will not only shed fresh light on the origin, causes and courses of some diseases and disabilities but that it can make unique contributions to preventive medicine and to the solution of congenital and environmental health problems.

There are exciting opportunities and provoking challenges on many biomedical research frontiers.

Developments in the field of molecular biology have the most fundamental implications for medicine. It has been suggested--and it is no exaggeration--that its ultimate effects on the practice of medicine will be as revolutionary as the discovery only a hundred years ago that diseases could be caused by germs.

The door to the inner workings of genetics has been pried open by such brilliant young scientists as Dr. Nirenberg of the National Heart Institute. We know enough to be reasonably sure that the intricate mechanisms controlling heredity also control--or at least influence--some aspects of the functioning of the organism throughout its life, probably including its predisposition to contract certain diseases. Much difficult work remains to be done--and, I may say, many

inspiring hunches will be needed--before we have a sufficient understanding of the genetic process to be able to apply our knowledge to the prevention or cure of congenital disabilities or weaknesses. But the rewards of success appear to be so promising that this field merits close attention and consistent support.

Although man has reproduced himself since the beginning of the species, the process by which this is accomplished is still so little understood that science is not prepared to give definitive answers to many of the urgent questions that now arise in connection with population control.

The Committee has during the past few years heard much testimony concerning the ubiquitous role that viruses may be playing in a wide range of diseases not heretofore suspected of having a viral origin. The apparent ability of viruses to continue to affect their host even after they seem to have disappeared not only indicates the difficulties encountered in virus research but also illustrates how a research pursuit can be frustrated simply by the lack of techniques for keeping the culprit in sight.

A beginning is now being made on the systematic study of environmental poisons--not only water pollution and air pollution but the cummulative affects of all kinds of chemicals and drugs which we breathe, swallow or touch in the course of our normal activites. The finger of suspicion has been pointed at some of these compounds not only as possible causes of disease but as having effects transmittable to our offspring.

While drugs are under surveillance for their possible dangers, the range of their effectiveness in the cure and alleviation of disease is constantly widening. This is particularly true in psychopharmacology which now holds out the hope that we may in the not too distant future be able to release a high proportion of the inmates of our mental institutions.

The behavioral sciences are becoming a significant concern of medical scientists, as it is increasingly recognized that man reacts--physiologically as well as psychologically--to all aspects of his environment. As this Committee is well aware, juvenile delinquency is, in a sense, a disease--like alcoholism, drug addiction or overeating. The line between the medical sciences and the behavioral sciences is disappearing in many areas and medical research is again taking as its province the attainment of the Roman ideal of "Mens sana in corpore sano"--a sound mind in a sound body.

A common feature of all these areas into which some of the major thrust of medical research is shifting is that they cut across the traditional categorical lines. It is already quite clear that much of the research effort of the future will be focused on fundamental biological processes whose disturbance (as, for example, by a virus) or malfunction (due, perhaps, to a genetic deficiency) results in a condition we recognize as a disease. Physicians have long known that treatment of the symptoms of a disease must, if possible, be accompanied

by treatment to remove its cause. Medical scientists similarly recognize that research focused on a disease must be accompanied by research into the biological process which underlies it. Research which starts with a normal biological process and explores the aberrations that result in disease is no less important to the advancement of medical knowledge--and is sometimes less difficult--than research which starts with a disease and seeks its causes. To achieve a proper balance between these two approaches must be one of our main concerns.

Another common feature of current developments in medical research is its increasing reliance--or even dependence--on methods, tools and techniques not traditionally associated with biology and medicine. Highly effective use is made--though still by too limited a circle of investigators--of concepts and instrumentation borrowed or adapted from the physical sciences. The instrumentation developed by physicists is far more sophisticated and refined than that in common use in medical research. Automation offers possibilities for routine laboratory and even clinical procedures which are only beginning to be explored.

The translation of biological phenomena into mathematical models presents a powerful tool for their systematic explorations--especially now that computer technology has made it feasible to perform extensive series of very complicated mathematical computations. The difficulty in this area is that there are, as yet, so few mathematical

generalizations in biology. There are so many variable factors and their relationships are so complex that it is extremely difficult to state them in mathematical terms. The work requires the combined efforts of biomedical scientists with a flair for understanding analogous mathematical concepts and mathematicians with a flair for understanding biological problems. Such teams are not easy to organize but can be most effective.

The creation of a Division of Computer Research and Technology at NIH is a significant step in our efforts to being the precise techniques of mathematics and the capabilities of data processing machines to bear on the solution of biomedical problems. This Division and the National Heart Institute are in process of installing an experimental computation-data conversion system in the Clinical Center which should make it possible to examine systematically and to relate a large volume of data derived from instruments used in physiological experiments. The Division is also working with the Clinical Pathology Department of the Clinical Center is pioneering automatic handling of laboratory data and its rapid correlation with existing data. One of the most important functions of the Division, however, will be to bring biological and medical scientists into close personal contact with sophisticated mathematical, engineering, and systems competence. The new Division will provide our intramural scientists with a new and powerful tool but the training it will provide

not merely in the mechanics of computer technology but in the underlying mathematical concepts may well be an even more important contribution to the long-range development of biomedical research.

There is also considerable scope in medical research for investigators with engineering talents. The medical application of miniaturized electronic equipment needs to be further explored and there are opportunities for mechanical and materials engineers. It should, for example, be possible to develop a cheap and effective plastic mold to replace the heavy and clumsy plaster casts which are still used to immobilize certain parts of the body.

A third feature of the changing methodology of medical research is the increased use of epidemiological studies and selective population surveys. These efforts, which can yield highly valuable results unobtainable through normal laboratory research or clinical investigation, often require the cooperation of statisticians, sociologists, social anthropol gists and, sometimes, even economic historians.

I have tried to sketch very briefly some of the ways in which biomedical research is changing its complexion. Federal support for this research must recognize these changes and make allowance, within the terms of national policy, for meeting the changing requirements.

One of the characteristics of research is that its costs usually increase as it matures. Each of the directions in which biomedical research is moving and the developmental programs which

will be necessary to incorporate research achievements into diagnostic and therapeutic practices will be costly. It must be expected that these costs will increasingly be reflected in future appropriation requests.

The management of Federal programs to support health-related research or to facilitate its application to health services must take careful account of their impact on the participating institutions. These institutions usually have important functions and responsibilities that lie outside the fields with which the Federal programs are concerned. It is essential that they retain full responsibility for the management of their own affairs--that they have control over their education, research, and service activities; are free to implement their own plans for institutional development; and have first call on the professional loyalty of their faculty and staff. Special care must be taken to ensure that the expansion of facilities and growth of institutional activities stimulated by the Federal Government will take a form which will strengthen, rather than weaken, the total program, the organizational integrity, and the unique character of each institution.

As you know, Mr. Chairman, some of the NIH programs--such as the institutional grants--are specifically designed to strengthen participating institutions while many others--including the various kinds of center grants--are implemented in a way that will have this effect.

We also hope to develop administrative procedures which will give grantee institutions a more realistic role in the management of grant-supported projects. A pilot study is now underway in which responsibility for changes in project budgets or uses of grant funds, which normally require prior approval by the Public Health Service, has been delegated--with suitable guidelines--to the executive echelon of seven of the largest grantee institutions [the Massachusetts General Hospital, Massachusetts Institute of Technology, Columbia University College of Physicians and Surgeons, Rockefeller Institute, University of Pennsylvania, Johns Hopkins University School of Medicine, and the University of Michigan]. The items covered by this arrangement are expenditures for office equipment, laboratory equipment costing more than $1,000, travel, hospitalization of patients, publication of books and monographs, tuition charges, and alterations or renovation up to a limit of $2,500. One of the purposes of the pilot study--which will be evaluated at the end of a year--is to develop procedures for assisting other institutions to improve their grants management. We believe that placing administrative authority for decisions of this kind in the hands of responsible administrators who are closest to the research activity, will not only improve the administration of grant funds but will better serve the scientific aims of the grant projects.

In giving increased attention to the institutional aspects of our support programs we are not, of course, losing sight of the importance of the individual grantees. Research is done by investigators--not by institutions or their administrators. The traditional NIH project grants must continue to be a major element in our program.

Any comprehensive assessment of the projects supported by NIH grants will show--as several recent reviews have, in fact, shown--that the quality of the research done has remained impressively high. There has, very properly, been concern--in the Congress, in the scientific community, in the Executive Branch and, indeed, at NIH itself--that the rapid expansion of the Federal support programs might lead to lower standards for the work considered eligible for support. I am certain, Mr. Chairman, that the overall quality of research has not merely been maintained but has risen significantly as a direct result of the expansion of the project grant programs.

I am happy to say that the quality of the work done by our grantees is fully matched by our intramural staff.

The maintenance of the stature of NIH as one of the outstanding research institutions in this country--and, indeed, in the world--is, of course, of great importance to the national medical research effort. The highly-qualified and dedicated scientists and technical staff who work in the Clinical Center and the NIH laboratories

in Bethesda, in Montana, in Panama, in Ghana, in Pakistan and, on special assignment, in other laboratories around the world are making significant contributions to the progress of biomedical science and its success in the constant battle against the onset and effects of disease. That these contributions are widely recognized and respected is shown by the awards and honors which NIH scientists continue to receive. For example, Dr. Marshall Nirenberg, who has already been widely honored for his major contribution to the understanding of the mechanics of genetics, was one of eleven scientists to whom the President awarded the National Medal of Science. The Bolivian Government has named a hospital and erected a bronze statue in memory of the late Dr. Henry K. Beye who, as director of the Middle American Research Unit, led the fight against Bolivian hemorrhagic fever. Dr. Willy Burgdorfer, of the Rocky Mountain Laboratory, received a John Simon Guggenheim Memorial fellowship for his distinguished work on viral and rickettsial infections.

I should like, if I may, Mr. Fogarty, to place in the record a listing of the awards received by members of the NIH scientific staff for the outstanding job they are doing.

The quality of the intramural research at NIH is equally important to the maintenance of the quality of the extramural programs. This works in two ways. The presence on the Bethesda

campus of a cross-section of clinical investigators and bench scientists who are working in the forward areas of the research frontier makes it possible for those responsible for the direction of the extramural programs to keep abreast of new research developments, to spot new research opportunities, and to anticipate future research trends. In a field which is developing as rapidly as biomedical research and which involves so many scientific disciplines and specialties, this relationship is essential to sensitive and responsive policy development and program management. The fact that this relationship exists at NIH and the acknowledged standing of NIH as a first-class research institution also serves, in a subtle but very real way, to make the biomedical research community more responsive to NIH leadership in developing national programs.

I am, however, very much worried, Mr. Chairman, about our ability to maintain high standards of scientific and administrative competence by the difficulties we have encountered in recruiting senior staff. The sort of persons we should like to have to develop new concepts and new approaches in an extremely broad and complex research area, can command much higher salaries--and with more attractive fringe benefits--in an academic institution than we are able to offer. The salary handicap is, for example, seriously affecting our ability to staff the new Division of Computer Research and Technology.

The effectiveness and viability of the NIH role in biomedical research--and, therefore, to a very large extent, the effectiveness of the whole national health research effort--will be significantly influenced by the quality of the professional staff in both the intramural and extramural programs. It is therefore essential that we should be able to recruit staff who not only have outstanding scientific and administrative competence but the vision to see the opportunities that lie ahead, the imagination to design fresh approaches to exploit those opportunities and the qualities of leadership necessary to insure that those approached are vigorously pursued.

The budget estimates for the Institutes and operating Divisions of NIH total $1,040,056,000. This amount represents an increase of $74 million, or about 7 percent, over the expected operating levels for the current year.

This budget, together with the funds that have been separately requested for Health Research Facilities Construction, direct construction, and the international activities using P.L. 480 funds, provides for a third year of restrained and selective growth following seven years of extraordinarily rapid expansion of the programs. The increases requested are focused on specific targets in areas of science in which progressive expansion seems most desirable--such as gerontology, child health, and toxicology.

An increase of $25 million--or about 6 percent--is requested for regular research project grants. Of this amount, approximately $19 million will enable us to meet commitments for the support of existing research projects (that is, noncompeting continuations). The other $6 million is requested to bring indirect cost payments by NIH into line with the current practice of other Federal grant-making agencies.

Increases totaling $18 million--or a little over 15 percent--are requested to strengthen the special research programs. Clinical research and special resource centers are playing an increasingly important part in extending this country's research capabilities to meet the challenges and exploit the opportunities that lie before us. The budget contains $57 million for these programs--an increase of $9.5 million, or nearly 17 percent, over their present level. The budget also includes an additional $6 million for the further expansion of the special grant program of the National Institute of Mental Health for hospital improvement. This program was started in fiscal year 1964 with an allocation of $6 million; the current allocation is $12 million; it is requested that $18 million be provided for fiscal 1966 for this important step in increasing the effectiveness of the treatment of mental illness.

Two new programs focused on areas in which there is both a great public need and a great scientific opportunity are included in the budget now before you. One is a request by the National Cancer Institute for $1.5 million to set up child leukemia centers. No cure for this tragic disease has yet been found but the curtains of mystery hiding its cause seem to be parting. The proposed centers will materially assist in accelerating leukemia research. The second new budget item is the proposal of the National Institute of General Medical Sciences to launch a program aimed at creating new resources for research and associated training in the fields of toxicology and pharmacology. As this Committee pointed out in its report on last year's appropriation bill, these two fields represent a deficiency in the NIH research programs--especially in the light of mounting evidence that prolonged exposure to many chemicals and drugs now common in our environment may have long-term effects on health and, possibly, on heredity. The budget includes $1 million for this program.

The budget includes an increase of a little over $19 million--or about 8-1/2 percent--for the fellowship and training grant programs. Over half of this increase is in the training grant programs of the National Institute of Mental Health. The major increases among the other Institutes are: a little over $3.6 million for the National Institute of General Medical Sciences (of which $1 million is for predoctoral fellowships); exactly $2 million for the National Institute

of Child Health and Human Development; and about $1.5 million each for the National Institute of Arthritis and Metabolic Diseases and the National Institute of Allergy and Infectious Diseases.

Considered by activity, two-thirds (or more than $13 million) of the requested increases for fellowships and training are to permit the funding of 165 additional graduate training grants bringing the total of these vitally important training projects to 3,373. A substantial increase--about $4 million or nearly 23 percent over the current appropriation--is also sought for Research Career Development awards. This program, launched in fiscal year 1962, has amply demonstrated its effectiveness. The increase requested will permit 166 additional awards bringing the total number of current awards to 1,119.

The increases requested in the budget now before you are modest but they will enable us to maintain the momentum of the present programs. It is, however, a tight budget with no slack in any of its components. It is, therefore, important that we have some flexibility in administering the NIH appropriations. Unforeseen developments are a normal feature of effective research, Mr. Chairman. In fact, if there were no unforeseen developments in the program of a research institution, I would begin to suspect that the institution was stagnating or doing very routine work. A vigorous research organization playing a major national role in a period of rapid scientific

developments cannot function as effectively as it should if it is bound too tightly to the details of budget estimates prepared twelve to eighteen months in advance.

The degree of flexibility necessary can be achieved by the provision, in the Bill now before you, authorizing the transfers up to 5 percent between NIH appropriations and by the removal of present limitations on reallocations within each of these appropriations. I should like to urge the Committee to give its most sympathetic consideration to these two requests.

During the past year there have been a number of changes among the directors of the Institutes and Divisions who will testify on the details of the various budget estimates.

Dr. Robert H. Felix has been succeeded as Director of the National Institute of Mental Health by Dr. Stanley F. Yolles. Dr. Yolles joined the staff of the Institute in 1954. He became Associate Director for Extramural Programs in 1960 and for the past year and a half has been its Deputy Director.

Dr. Clinton C. Powell, the first Director of the new National Institute of General Medical Sciences, has been succeeded by Dr. Frederick L. Stone who has been associated with the NIH extramural programs since 1958 including four years as Assistant Chief of the former Division of General Medical Sciences. He became Chief of the Division of Research Facilities and Resources when that was created in 1962. For the time being, Dr. Stone will continue to act in the latter capacity also.

Dr. Justin M. Andrews, the director of the National Institute of Allergy and Infectious Diseases, has retired. The new director is Dr. Dorland J. Davis who has been the Institute's Associate Director for Intramural Research since 1956.

Dr. Charles V. Kidd has been succeeded as Chief of the Office of International Research by Dr. Charles L. Williams, Jr., who has been Associate Director for International Relations in the Office of International Health in the Office of the Surgeon General.

I shall, of course, be happy to answer any questions which the Committee may have.

Thank you, Mr. Chairman.

TAB 44

STATE OF THE ART AND PROSPECTS OF BIOMEDICAL SCIENCES WITH PARTICULAR APPLICATION TO HAWAII*

James A. Shannon, M.D.**

Thank you, Dr. Hamilton.

With reference to Mr. Lehan's paper, it was said in the mid-'50's that the greatest accomplishment of World War II was to teach physicists how to spend money effectively. I'm afraid I will have to say that the same is true of engineers in the '50's and '60's. When Mr. Lehan speaks of aerospace, what he is really talking about is the application of systems analysis to very complex problems. He is not talking about any specific segment of science, but rather about a technique for solving problems. And I would agree with him that this is something that is currently of very little concern to most universities and, more importantly, most technological institutes.

The technique had a long background of growth. It probably began during World War II in what was then called operations research and in attempts to determine the cost effectiveness of various types of bombing and the like. The payoff came only when we were able to go into Europe through the underground and really find out what was doing what and

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** Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

how much. I would also like to point out that the field has grown because it has been populated primarily by young people with a general lack of inhibition in the tasks they have undertaken. The reason these young people are being sought for general management of problems today is, first, that they have the technique, and second, that they are becoming progressively more unemployed. So, what you see here is a scientific and technological mix with great capacity, great imagination, and without inhibition.

I am going to talk about the biomedical sciences and try to give a factual presentation of some of the selling features of these areas of science as we see them, and then talk about the role of Hawaii as we see that. First, may I say, Dr. Hamilton, I am delighted to have the opportunity to attend this conference. We have been interested in Hawaii--"we" as an institution, that is--for many years. We recognize that the coming of age in terms of statehood raises many questions for which sound answers will have to be found. As a granting agency, we have been impressed by the development of the universities, and particularly, by the drive on the part of the University of Hawaii to develop true excellence. This is hard to come by, and the fate of the University is by no means determined at the present time. There are many fundamental decisions that have to be made during the next year or two, the payoff of which may take 2 to 15 years but, nonetheless, will determine, to my mind, what will be here 10 to 15 years from now. I have some data published by the National Science Foundation, and the material on manpower is taken from

University bulletins. I want to emphasize that they in no way reflect the University's plans, but do, I believe, define the base from which the University must start in approaching its long-term problems.

At the outset, however, I should like to talk about the present state of biomedical research in general without regard to location. Let's return to this concept of the "state of the art." We are inclined to think that the state of the art is not basically subject to control, because it is related to innumerable advances that are determined by the depth and scope of many contributing disciplines--advances that cannot be controlled in mission-oriented activities, but rather reflect the broad, indeterminate base that has developed so rapidly in our country. One might ask, for example, if in the field of microbiology, the state of the art in 1918 was such that, given any sum of money, the problem of poliomyelitis could have been broken at that time. Or, with any amount of funding and any amount of effort, could one have developed in the period following 1918 what we know today to be heart surgery? In both cases, I believe, the answer is no. The art at that time was grossly inadequate for anybody by any means to have solved those very practical problems.

It is in terms such as these, I think, that we should assess the state of the art today in attempting to expand the frontier of biomedical knowledge. Fundamentally, the question is this: Is there a point in the support of science, particularly biomedical science, beyond which the returns necessarily diminish sharply as a result of intrinsic

limitations or immutable conditions, social, economic, or technological? This is a question that we as a supportive agency must consider on an annual basis in presenting our case to the Congress.

It is my conviction that the biological sciences in general are not even close to the point where diminishing returns are in sight. In point of fact, the biological sciences have benefited tremendously by the prior emphasis in the '30's and '40's on chemistry, and in the '40's and '50's on physics. We are the recipients of the broad benefits of an $18.5 billion research and development program-- benefits that have scarcely been put to use in the fields of biology and medicine. And in view of the national expenditures for medical and health-related research totalling $1.5 billion last year, we are not talking about puny sums. Moreover, one sees extraordinary acceleration of activity, productive activity, on all fronts.

The problem here is not the lack of research opportunity, but the lack of scientific resources, particularly trained manpower. What is faced now is the need to select goals, to select goals quite broadly, and these may be goals of the most fundamental research. For example, to what extent do we wish to deploy our resources so that fields of cell biology and molecular biology will flourish at the most rapid rate possible? To what extent will we approach the very active field of genetics? And again, to what extent shall we take advantage of the opportunities that are open in the study of viruses, either in relation to some of the obscure diseases or to the possibile capability of viruses

to produce cancer? These are decisions that must be made. In a comparable way, one must also decide how much money, or what part of any given fund, shall be applied to some of the very practical problems of the day.

My first contact with the aerospace industry as such was the cutback in NASA's budget. Several West Coast firms called on us to determine whether it would be possible for us to support some of the activities they thought they could do. Those activities were of a very practical nature. They were engineer-oriented, the basic data already available; and they ranged from the development of external mechanisms for supporting the heart, through the development of artificial kidneys, to the automation of serologic diagnosis. Lockheed, for instance, felt that the time had come to build a fully automated hospital. And I am sure that each of things could be done. The problem, though, is that the funds available to us, which generally go for much more modest projects, are literally insufficient to approach these broad technological problems.

The American people are going to have to decide within the next year or two how much they want an external support mechanism of the heart. How much do they want a convenient artificial kidney? When the question is posed that way, I think the answer will be that we want it regardless of cost. There are tens of thousands of people across the nation who are dying because of failing kidneys and could be saved with an effective artificial one. At the present time, it costs $10,000 a year

to maintain one person in normal life whose kidneys are shot. Obviously, the cost of present techniques runs too high. But the point I am trying to make is that we are not limited by the so-called state of the art. We are at a stage where, as a nation, it becomes critically important for us to make certain broad decisions and elect where we will go. These decisions in part will relate to that which is quite fundamental as well as to that which is quite applied. We must decide on a balance between the scientific opportunities and what our people are willing to support in terms of taxes. It is in this light that Hawaii must make some difficult decisions. It is my feeling that the very rapid growth in science is probably over and that the next 10 years will see a selection of one project or another, or a substitution of one objective for another.

In speaking of the competitive nature of institutions in relation to science, there has come into being a consensus that a community, say the size of a State, must have a broad academic base and a variety of industrial enterprises. Only in this way can we move from the hard labor of the farm into the relative comfort of suburban life, which all America is apparently trying to do now.

I would say that in the biological sciences, more particularly biomedical sciences, we now have a very broad base, and that this will be one of the areas in which, despite expansion at a moderate rate, the problem of selection becomes important. Now, in looking at problems as broad as oceanography, you find the biological scientists having as

great a capability to make broad contributions as the engineer or the physicist. I make this point only to emphasize that the potential of a field must be carefully weighed. As I have said, the '30's and '40's were periods of emphasis on the chemical sciences, the '40's and '50's the physical sciences, particularly physics with its engineering overlay. And I would hazard a guess that the '60's and '70's are going to be progressively dominated by problems and goals which conventionally come into the biological frame of reference. For the university that is looking itself over from the standpoint of determining how it will grow, I think such conclusions have fairly serious consequences, if valid; at least the question should be posed.

I should like to turn to the matter of support of science and say a few words on the impact of this type of activity on an institution like the University of Hawaii. I will again emphasize that the National Institutes of Health, a Federal installation, is responsible to the taxpayer for the efficient and effective utilization of the funds made available to it, and consequently, it supports excellence and only excellence as best one can determine it. We are not a philanthropic agency with social motives that go beyond getting good science for the funds we have available. But within that context, I would point out that it is possible to use our funds, as the National Science Foundation and other agencies use funds, to create centers of excellence where a nucleus of talent exists. In other words, no center of excellence happens suddenly and automatically. It happens because

one or two, perhaps four or five, really good people do productive work and, more importantly, attract top-flight graduate students. Given this as a beginning, an institution has a basis for quite broad and fairly rapid expansion.

Now, our ability to support that type of activity requires no compromise with the competitive nature of the support system, because we have a responsibility not only to support good science but to provide a base for its logical expansion. We say that a center of excellence, or numerous centers of excellence, are important, because each of these fosters the development of an environment for ideas, of interdisciplinary approaches, of talent, and the salutary competition of one center with another.

With such thoughts in mind, we have taken a fairly hard look at the University of Hawaii in relation to the role it might best play as viewed by an interested observer from outside. From the standpoint of health research, we find in Hawaii a location that offers good opportunities to study ecology, health and disease patterns, and an ethnic composition of the population which are not available to us within any of the States that we usually deal with. We find that full statehood enables U. S. agencies to support, without any problems of foreign policy restrictions, the biomedical studies that tend to exploit such exotic conditions.

Let me give you an example of a very practical problem. This isn't profound, but shows nonetheless the key role that Hawaii can play in

such a problem as this. The Japanese have a high incidence of gastric cancer, whereas this form of cancer is almost disappearing in the United States. The question, of course, is whether this difference is due to hereditary or environmental influences. We arranged to study over a ten-year period a substantial number of Japanese both in Japan and in Hawaii, to determine whether the Japanese is inherently susceptible to gastric cancer or encounters the causative factor in his environment. The findings, which will determine the course of our study from now on, were that the Japanese in Japan had a high gastric cancer rate, those in Hawaii had gastric cancer just as does your total population, and those on the West Coast were within the U. S. norm. Now, this is a sharp answer that removes immediately any consideration of a vague hereditary component or genetic predisposition to this disease.

There are many other areas where the ethnic mix in Hawaii provides, if not an easy solution, at least possible solutions to problems that could not be approached elsewhere. I might point out, on the other hand, that very few of these studies are under way at the present time. It might surprise you to know, because you are climate conscious, that in the census studied in 1958-59 the allergies, asthmas and hayfever were evidently among your most important chronic problems. But we have looked through our grant activities in support of scientific research on the islands and find very little work going on in that field.

Support from the local population is usually given because the people believe in a great university. And a great university has a broad community responsibility as well as intellectual responsibility to its people. We ran into a curious thing which I will illustrate with a very practical problem. We are probably supporting more research on leprosy in Carville, La., and in Baltimore, Md., than we are on Molokai. This is simply because the scientists who are interested in leprosy are largely in Baltimore or Carville. Now, leprosy is an important disease problem in itself. It is caused by an organism within the class of Mycobacteria, which also contains the organism of tuberculosis. In the aggregate--and often combined with malnutrition--this is the most important group of diseases in the world. Planning to exploit a research opportunity like leprosy, then, is important in the strategy of a place like the University of Hawaii. One asks, What are the areas where opportunities for great contribution lie? Can we gather together in this institution the interested scientists scattered throughout the States, who being scattered cannot achieve a critical mass for really rapid progress? Can we provide a setting where such progress will take place? This is analogous to the early establishment of our Rocky Mountain Laboratory in Montana, with a view to studying indigenous health problems and attracting competent scientists through the opportunities to do productive work together. Among the outstanding achievements of that group, as you may know, was the discovery of the cause and cure of Rocky Mountain spotted fever. In other words, it is

a problem of selecting the physicists, biophysicists, chemists, microbiologists, etc., who not only have the capability of interacting productively with one another but who will come to a remote place for research opportunity and the sense of adventure.

I might point out that universities will not get good scientists unless they are willing to pay them well, and this includes adequate housing and adequate social life. There are now 16 new medical schools under way on the continent, and by 1970 or 1975 there should be at least 25 new schools--perhaps as many as 40. New schools are paying adequate salaries and providing adequate resources, which in general were there before the scientists were invited to come. This is an expensive business. However, the investment in higher education and medical education pays off many times in social returns. We can help, but it is going to require a great deal of local resources.

I am a great believer in the maxim "Make no little plans." In 1960 more than 150,000 persons in Hawaii's total population were less than nine years old. In planning ahead, Hawaii must provide adequate educational opportunities for these children who will reach college age and, indeed, graduate-school age in the 1970-75 period. Based upon annual statistics published by the U. S. Office of Education, it

appears that present enrollment in Hawaiian institutions of higher education is rising almost twice as rapidly as for the United States as a whole.

Moreover, the proportion of Ph.D.'s awarded appears to be moving westward. For example, in the 1940-44 period the Pacific region awarded 9 percent of all Ph.D.'s; but in 1960-61 the region awarded 13 percent, roughly a 50 percent increase in one generation. While Hawaii's share is still minute, it is of interest to note that the proportion of Ph.D.'s awarded by Hawaii rose from .01 percent in 1950-54 to .05 percent in 1960-61. Thus it is important to distinguish between an analysis of today's situation and tomorrow's opportunities, taking into account population and educational trends as well as rising expectations of the American people with respect to the provision of health services.

Now, I'd like to make a point or two regarding the composition of the University of Hawaii as seen from the standpoint of one who is solely interested in its capacity to attract and hold competent scientists and to do first-rate biomedical research. The data at my disposal were those in your catalog describing science programs in the College of Arts and Sciences, particularly the number of courses available and the faculty involved. An important thing to us, in trying to view the University broadly, is that the graduate school in science areas, as the catalog

presents it, is almost nonexistent. (Table 1.) A second point is that the faculty at the professorial level is pretty evenly distributed across all the sciences without apparent emphasis on any, except perhaps on zoology. Mathematics shows up as being inadequate.

In 1964 the University of Hawaii had a total enrollment, for purposes of acquiring degrees, of 14,312 students, as shown in table 2. The number of students enrolled for advanced degrees, judging from the trend, was probably upward of 1000. Yet, we see in table 3 that only 14 Ph.D.'s were conferred in 1964, of which only 4 were in the biosciences. Again viewing the university from outside, this means that a large proportion of the graduate students are short-term--that is, those who go for a year or two and no longer. The high ratio of total enrollment to doctorates conferred, 1000 to 1--taking into account the fact that the master's degree is not too important to the scientific professions--is not an adequate base on which to build an environment for productive research effort.

I don't want you to take this too seriously, but we looked over the record of NIH support to the University of Hawaii and to the total State for the past five-year period. We used what we call a priority score, which is the relative merit as assigned by our advisors in awarding grants. The most excellent applications would be at the level of 100, and those just acceptable (though probably not payable) would be 500. The lower the priority, the better the project. Now, we think it may be significant that, both in the State and in the

University, there has been some increase in the priority score as the number of grants have gone from 24 to 45, as shown in table 4. In other words, there could be some decline in average quality, (Table -- about here.)

We know that average priority scores, to a large degree, reflect the quality of an institution in terms of biomedical research productivity. Generally speaking, the scores that we get from Harvard, Princeton, Columbia, Chicago, and like universities average 200 and below, and the less adequate medical schools will average considerably higher. Now, this is not an indictment, please believe me, of Hawaiian science, because the number is still small, the dollar value a million-to-one; but it does suggest that in moving from 24 to 45 grants, and roughly tripling the amount of money expended, there is no indication that the new science is better than that of five years ago. In a school that is developing its resources with a view to creating a center of excellence, I think this could be a disturbing thought.

The major decisions that will determine actions in the next 10 to 15 years are before you. I will emphasize only two things: One, you will have strong competition because others throughout the Nation are also striving for excellence. In this competition, unfortunately, the almighty dollar plays a very important role. One finds that he can accommodate himself to the cold weather of Minnesota, the humid weather of the Gulf Coast, or the metropolitan areas of New York or San Francisco and get along well--if he can satisfy the needs of his family and the education of his youngsters. And I have no idea what your salary schedules or benefits are; I can only say that unless they are adequate, you will not be able to compete for the top talent.

The second thing is that one of your best opportunities is to attract young scientists, because you can provide better resources and facilities than they have at the present time. Currently, Harvard, Princeton, the University of Chicago, Columbia, and other great universities are at a tremendous disadvantage because their young people are crowded to the extent that they cannot develop their independent capabilities. But you will have to mortgage the future, as it were: you will have to make the capital investment, and they will pay the dividends.

Many university administrators are unwilling to accept the fact that the annual cost of running an activity is roughly the same as the capital investment to initiate it. A $5 million facility will cost, in the health field at any rate, about $5 million a year to run. And programs for science are still in the period of moderate expansion. The Federal Government, or more specifically the congressional committees, are taking a fairly enlightened view of what they will allow the constituent agencies to do in this drive to expand the base of higher education. And I think that during the coming 10 years, there will be at least 10 and perhaps 25 new centers of excellence. These will play a very important role in the further development of our Nation. I will emphasize that they will be self-selected, which requires local initiative and substantial local funds to get the program off the ground.

I wish I could have been gentler, but I have tried to be frank. Thank you.

TABLE 1
SCIENCE PROGRAMS IN THE COLLEGE OF
ARTS AND SCIENCES, UNIVERSITY OF HAWAII, 1964–1965

Area of study	Faculty							
	Prof.*		Assoc. Prof.		Assist. Prof.		Instr.		Lect.		No. of courses		
	Drs.	No dr.	Drs.	No dr.	Drs.	No dr.	Drs.	No dr.	Drs.	No dr.	Lower level	Upper level	Grad. level
Anthropology	3	–	3	–	5	–	–	1	–	–	1	25	11
Botany	3	–	3	–	1	–	–	–	–	–	3	13	18
Chemistry†	2	–	6	–	4	–	–	–	–	–	9	12	25
Geology	3	1	1	–	2	–	–	–	1	1	2	22	21
Mathematics	1	–	2	1	2	8	–	9	1	1	11	19	12
Meteorology	3	–	–	–	–	3	–	–	–	–	1	9	14
Microbiology	3	–	1	–	2	–	–	–	–	–	4	5	9
Physics	5	1	5	–	1	1	–	1	–	–	12	13	19
Psychology	5	–	4	1	1	1	–	–	1	–	2	20	27
Zoology	10	–	1	–	3	–	–	–	–	–	5	23	20
Graduate school													
Biochemistry and biophysics	1	–	1	–	3	–	–	–	–	–	–	2	17
Genetics	2	–	1	–	–	–	–	–	–	–	–	4	10
Oceanography	2	1	–	–	1	1	–	–	–	–	–	1	23

* Includes senior professors.

† Accredited by Committee on Professional Training, American Chemical Society.

TABLE 2

ENROLLMENT–UNIVERSITY OF HAWAII, 1920–1964

Year	Total* enrollment	Enrollment for advanced degrees	Grad. enroll. for advanced degrees as % of tot. enroll.	Graduate enrollment in biosciences
1920	171	NA†	NA	NA
1930	965	NA	NA	NA
1940	2,703	NA	NA	NA
1950	5,908	NA	NA	NA
1955	6,273	NA	NA	NA
1960	9,410	237	2.5	43
1961	10,250	553	5.4	86
1962	11,575	753	6.5	120
1963	12,972	933	7.2	144
1964	14,312	NA	NA	NA

*For fall of the year.

†NA = not available.

TABLE 3

DEGREES–UNIVERSITY OF HAWAII, 1920–1964

Year	Degrees conferred		
	Bachelor's*	Master's	Ph.D.'s
1920	7	1	
1930	132	20	1930-39: 2
1940	228	2	
1950	668	34	1950-59: 15
1955	658	30	2
1960	936	63	10
1961	840	101	6
1962	884	96	2
1963	973	231	15
1964	1,003	284	14
	Bioscience degrees		
1964	(38)	(36)	(4)

* Includes first-professional degrees of more than 4 years – about 20 in 1964

TABLE 4
PRIORITY SCORES FOR NEW RESEARCH GRANT APPLICATIONS FROM HAWAII AND UNIVERSITY OF HAWAII, 1960 - 1964*
(Dollars in thousands)

Year	Total State of Hawaii			University of Hawaii		
	No. of research grants	Dollars	Mean priority score	No. of research grants	Dollars	Mean priority score
1960	24	$ 311	224	16	$173	216
1961	26	514	223	16	266	247
1962	31	709	254	22	568	258
1963	36	1,000	229	28	595	248
1964	45	1,113	261	34	819	270

* Priorities range in ascending order from 500 to 100. Mean score for all NIH research grants ranges around 257 - 258

TAB 45

THE ORGANIZATION AND FUNCTIONS OF THE NATIONAL INSTITUTES OF HEALTH

The charts following this text serve to portray the organization and functions of the National Institutes of Health in relation to science nationally. They also represent the role of Federal versus private contributions, and some of the quantitative aspects of the NIH program.

ORGANIZATION

The first chart shows the organization of NIH. It should be pointed out that the basic concept is one of decentralization, wherein NIH does not, of itself, play an operational role, but rather operates through its constituent institutes and divisions. Within the NIH structure, the middle line (Mental, Cancer, etc.) represents National Institutes organized to attack certain categories of disease. The line above this designates four noncategorical programs, and the bottom line three service divisions.

RELATION OF MEDICAL TO TOTAL RESEARCH

Chart 2, which makes a very important point, is a pie chart illustrating the relationship of medical research as a proportion of all research and development in the United States. The size of the concentric circles roughly represents the magnitude of the total research and development effort in all areas of science and technology. The outer circle represents an increase in all R & D from $2.9 billion in 1950 to $18.5 billion in 1963. This includes both Federal and non-Federal research, in all fields of science. The wedges

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represent all medical and health-related research, which totaled $161 million and $1.5 billion for those years.

A critical point is that medical research bears a fairly constant relationship to the totality of research in the Nation during this period from 1950 to 1963. Much of this expansion of medical research is due in part to a parallel expansion of physical and engineering research. This reflects a movement into an age where science has emerged as one of the more important elements in our national life.

SOURCES OF MEDICAL RESEARCH FUNDS

Chart 3 provides an analysis of sources of medical research funds. A series of pertinent conclusions can be drawn from this chart. In the first place, there has been a pronounced expansion of medical research. The important factor, however, is that in contrast to all other areas of research and development, increases in support of medical science from private sources parallel increases in support from Federal sources. Prior to 1947, there was little Federal support of biomedical science save that which was done in Federal laboratories. This point marked the beginning of the grant program. In the past 17 years, the rate of increase of non-Federal support of the medical sciences has not been unlike the Federal: both have increased substantially. But there has been a marked change in their relative position, with Federal support now the dominant factor.

The inference to be drawn from this is that the establishment of a broad centralized operation for support of medical science through the expenditure of Federal funds has in no way dried up support of medical science from other sources. Instead, it appears to have stimulated it.

Contrary to other areas of science where there has been a withdrawal of private funds for support, the very nature of the private contributions to medical research, both industrial and personal, indicates a determination on the part of the American people to obtain better health through research.

NIH PORTION OF MEDICAL RESEARCH SUPPORT

Chart 4 is particularly significant to the programs of the National Institutes of Health. It is a pie chart with four segments relating to the sources of funds for medical research. NIH supports 39 percent of all medical science in this country; other Federal agencies, 24 percent; industry, 25 percent; and other non-Federal agencies, 12 percent.

Taking into consideration the fact that the industrial segment is limited to the pharmaceutical industry, which in general focuses its research activity on its manufacturing objectives, then the contribution of NIH for support of all medical research in this country becomes an increasingly important factor and NIH becomes the dominent influence in the support of biomedical sciences across the Nation.

A lesson to be drawn from this is that while it is within our capabilities to influence the biomedical sciences for the better, depending on the terms and conditions which relate our activities to the centers of higher education, NIH is in a position to dominate adversely this area of science if its mechanisms are unsuitable. Hence, to summarize, this chart points out the special obligation of NIH to exercise mature thought, sound administrative procedures, and at the same time, sound administrative restraints in providing broad potential control over such a large segment of science.

FEDERAL SUPPORT AT UNIVERSITIES

Chart 5 shows trends in Federal support of research at colleges and universities. It should be noted that this is for all research, physical as well as biological and medical.

In 1952 research expenditures within institutions of higher learning were dominated by the defense dollar, at which point in time some 70 percent of all federally supported science in the colleges and universities was contained within the appropriation of the Department of Defense.

Now, as the programs have grown, the actual dollar value of the defense support has increased but has lost its dominant position, and at present the three dominant agencies are the National Institutes of Health, the National Science Foundation, and the National Aeronautics and Space Administration. The programs of these agencies are all essentially civilian, civilian motivated, nondefense type activities.

This chart, in addition, shows another factor not commonly appreciated. Medical research is normally thought of and is equated with research in medical schools and hospitals. But with the progressive development of new instrumentation and a more penetrating view of the underlying fundamentals of biology and their relevance to health and disease, it has now become possible to obtain a searching insight into some of the more basic biological processes, through a whole array of university disciplines significant to areas of this sort.

RESEARCH GRANTS TO MEDICAL SCHOOLS

Chart 6 serves to emphasize this point. Here the percentage of funds that go to medical schools is compared with the funds that go to all other

types of institutions. It reflects the broadening of the biomedical research base through the exploration of related scientific disciplines.

NATIONAL INSTITUTES OF HEALTH GROWTH

Chart 7 shows the growth of NIH as related to its functions. It covers a 15-year period, during which programs went from a point near the bottom of the chart to the top of the scale, over the $1 billion mark. It might be noted that instead of a heterogeneous, scatter type of explosion, here is portrayed a carefully planned growth which has gone through some very purposeful developmental periods.

Some of the more striking changes can be pointed out. Very important is the period between 1950 and 1956, representing a fairly level program after an immediate postwar growth. In 1956 a judgment was reached by the Secretary of Health, Education, and Welfare that funds expended for medical research were grossly inadequate, both in terms of the opportunity and in terms of breadth and importance of the health problem. He recommended an unprecedented increase of the NIH budget, stating that limitation on the rate of growth in the medical sciences should be the rate of development of scientific personnel and resources, not the availability of funds.

This budget was taken by the House and by the Senate, the principles endorsed, and substantially more appropriated for fiscal year 1957 than had been recommended. This was a turning point in the programs of NIH. It was then that the stable program for research facilities construction was started. This program as well as a substantial increase in funds for the conduct and support of research produced an abrupt upswing, and the trend does not begin to change until 1963.

At the present time support and conduct of research amounts to 65 percent of the total program; the development of resources, 31 percent; and all other operations in the budget, 4 percent. The latter have included State control programs, professional and technical assistance, direct training, program direction, review and approval, and biologics control.

It should be pointed out that for each $2 spent in support of current research, approximately $1 is spent on resources for the future. This should be appreciated in any consideration of the rapid growth of the program. One must realize that this relationship, between a very heavy investment in the future and, at the same time, a broad support of current research, is what has permitted NIH programs to grow without a sacrifice of quality.

PROGRAMS OF THE NINE INSTITUTES

Chart 8 shows the programs of the institutes, giving a relative breakdown of how the appropriations are spread in 1965. The grants and awards programs are shown on the right and direct operations on the left. In the bars looking to the right, the first portion depicts support of research; next, the support of training; and last, support of fellowships.

It should be pointed out that consequent to decisions reached in 1956, it was decided to take out of the categorical institutes many of the functions that might better be done on a noncategorical basis. This resulted in a planned development of the National Institute of General Medical Sciences as a centralized point for support of both research and training in areas which were not truly categorical in nature but which had a relevance to all of the categorical areas. This was established first as a division in 1958 and then

as an institute in 1963. The latter year also saw the establishment of another noncategorical institute, the National Institute of Child Health and Human Development. Hence, growth of NIH to the present time can be seen as the consequence of the careful planning which took place in the summer of 1956.

MEDICAL RESEARCH MANPOWER

The next chart (9) looks into the future. Medical science will continue to prosper, depending largely upon the extent to which needs for a superior type of manpower can be satisfied.

These needs are quantitative. The figures are reflected in the pie charts. The ability to obtain adequately trained people will be determined in no small measure by the attitude of the Federal Government toward the development of personnel in these general categories.

For example, the requirement for M.D.'s in 1970 cannot be made up without expanding the present plant for the development of physicians. At present, about 8 percent of all graduating physicians enter into research and academic medicine. To double this number at the present level of production would seriously impair the availability of physicians to the people.

In the Ph.D. category, it is quite apparent that the point has been reached where personnel requirements cannot be satisfied by the simple diversion to medical research of wholly trained people. It will be necessary to participate in the basic training of these scientists.

RESEARCH GRANT PROCEDURE

The next and last is a flow chart showing how a research grant is made. The same process or a somewhat analogous process would obtain for the

fellowship program and the training grant program.

There are several important points that should be emphasized. It should be pointed out that the grant programs in general depend on the basic concept that worthwhile scientific activities to be undertaken arise not in the mind of the Administrator in Bethesda, but rather in the scientist's mind and the environment in which he works. Assuming that a scientist has a stable scientific environment, that he has adequate training, that he has adequate resources, and his institution will sponsor his application, he has the ability to apply to NIH for support to do things he feels are scientifically important.

The application comes to the Division of Research Grants. On arrival, an appraisal is made as to whether the piece of work proposed in the application is most relevant to heart research, cancer, or some other area. Based on this judgment, an assignment is made to the institute that has funds appropriated to support the work proposed. But at this time the grant is not submitted to that institute for action; it is retained within the Division of Research Grants, and a copy is sent for informational purposes to the institute concerned. The next step in the grant process is that the application goes to a study section for scientific review.

Now, all grants do not go to a regularly established study section, although the bulk of them do. Many grants are sufficiently complex as to require the establishment of special study groups for their review. Such special review groups have been formed for a limited number of programs and actually for individual projects if they are large enough. But in all cases the Division of

Research Grants accepts the responsibility of giving advice to the council concerned--advice of a purely technical nature as to the competence of the scientist, the adequacy of his resources, the conciseness with which he can visualize his problem, the merits of his proposal, and the reasonableness of his research approach.

Thus, in reaching conclusions, there is a combined judgment that includes also an evaluation of the net worth of the scientist on the one hand and the net worth of the scientific environment on the other. One judgment is that the work is good science and should be supported, or that it is not good science and should not be supported. The second judgment, assuming that the work is considered supportable, involves ranking the application in respect to its relative merit in comparison with other applications that are before the review group at that time. This is the priority system.

Each member of the study section assigns a rating by individual vote. The final priority rating of the application is a simple average of the individual ratings. The highest rating in such priority that one can get is 100, the lowest 500; but even an application receiving a rating of 500 has had a preliminary recommendation by this group that the work should be supported. This priority rating is useful to the Council. It is not followed blindly. But, as is usually the case in appropriations where funds are not available to pay all research grants, the priority gives a ranking of merit as best it can.

The research grant application then goes to the institute for program evaluation, together with the study section recommendation for approval or

disapproval, and the priority. Institute staffs undertake program evaluation of the application so that in discussing this particular project with their council, they can point out where this proposed activity fits into the overall scale of things as far as the institute is concerned. The council does not look at every individual application with this degree of detail; but this staff analysis of the relative role of such proposals in the overall program of the institute, particularly in respect to new grants, permits the council to determine where relative emphasis is going, assuming that certain actions are taken.

In the light of these considerations, the appropriate National Advisory Council then recommends whether to approve or disapprove the grant application. The institute director cannot make a grant for a project unless the council recommends such action. If the council recommends it, the institute director does not have to make it. So he can take a negative action, but he cannot take a positive action without council recommendation.

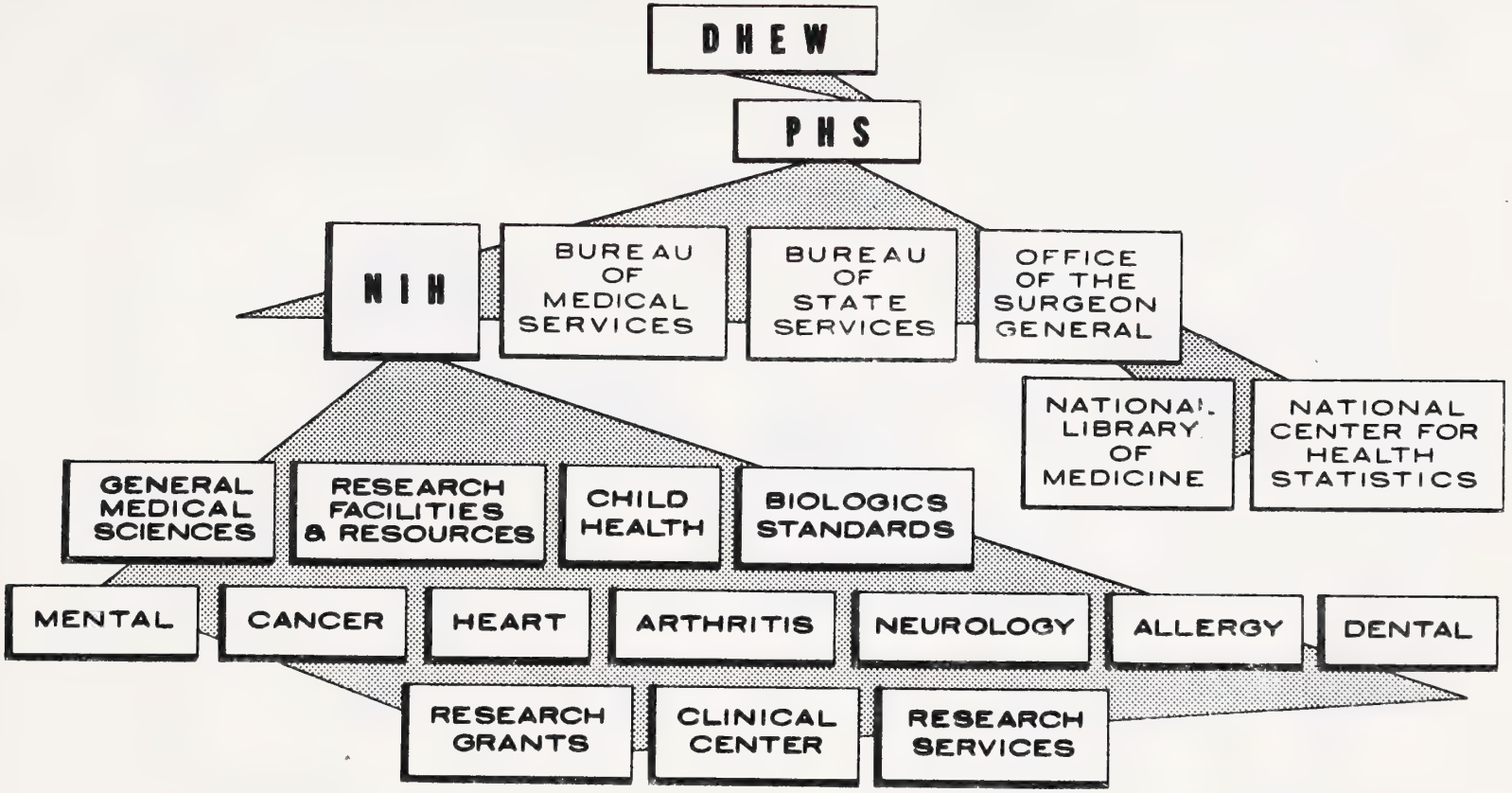
Always when a grant is made, the general order of magnitude of the dollar commitment is indicated, and this is subject to further negotiation with the investigator in order to determine the specific dollar amount. Commitments of support for subsequent years are frequently made in connection with the award of grants. These, with all other things being equal and annual appropriations being available as they have been in the past, constitute a moral commitment against next year's appropriation for continued support. This process ensures that investigations are not turned on and off on an annual basis.

No projects are supported for less than two years. A time period of support is provided which will enable the investigator to make a substantial

scientific contribution, which in turn can be assessed in determining further support action. The individual reports to NIH on an annual basis. The annual reports are not submitted in great detail unless the grant comes up for renewal. Then the progress report is quite detailed, and the investigator's future needs are determined at that time.

In general, the system is designed to assure the maintenance of a program through which scientists throughout the Nation can obtain funds on the basis of merit, in support of the search for new knowledge that will further the categorical research missions of the Public Health Service.

NATIONAL INSTITUTES OF HEALTH



MEDICAL RESEARCH AS A PROPORTION OF ALL RESEARCH AND DEVELOPMENT

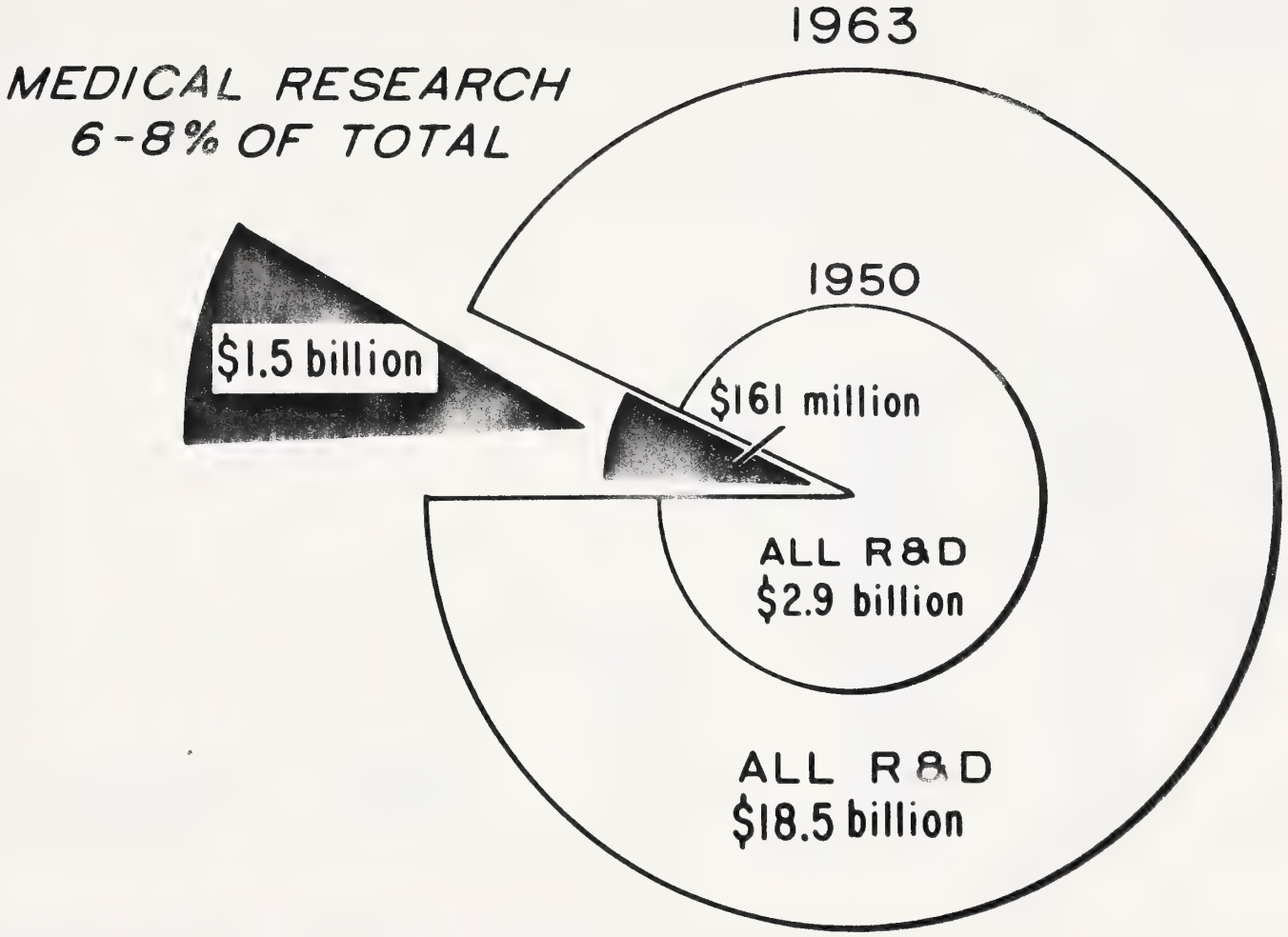
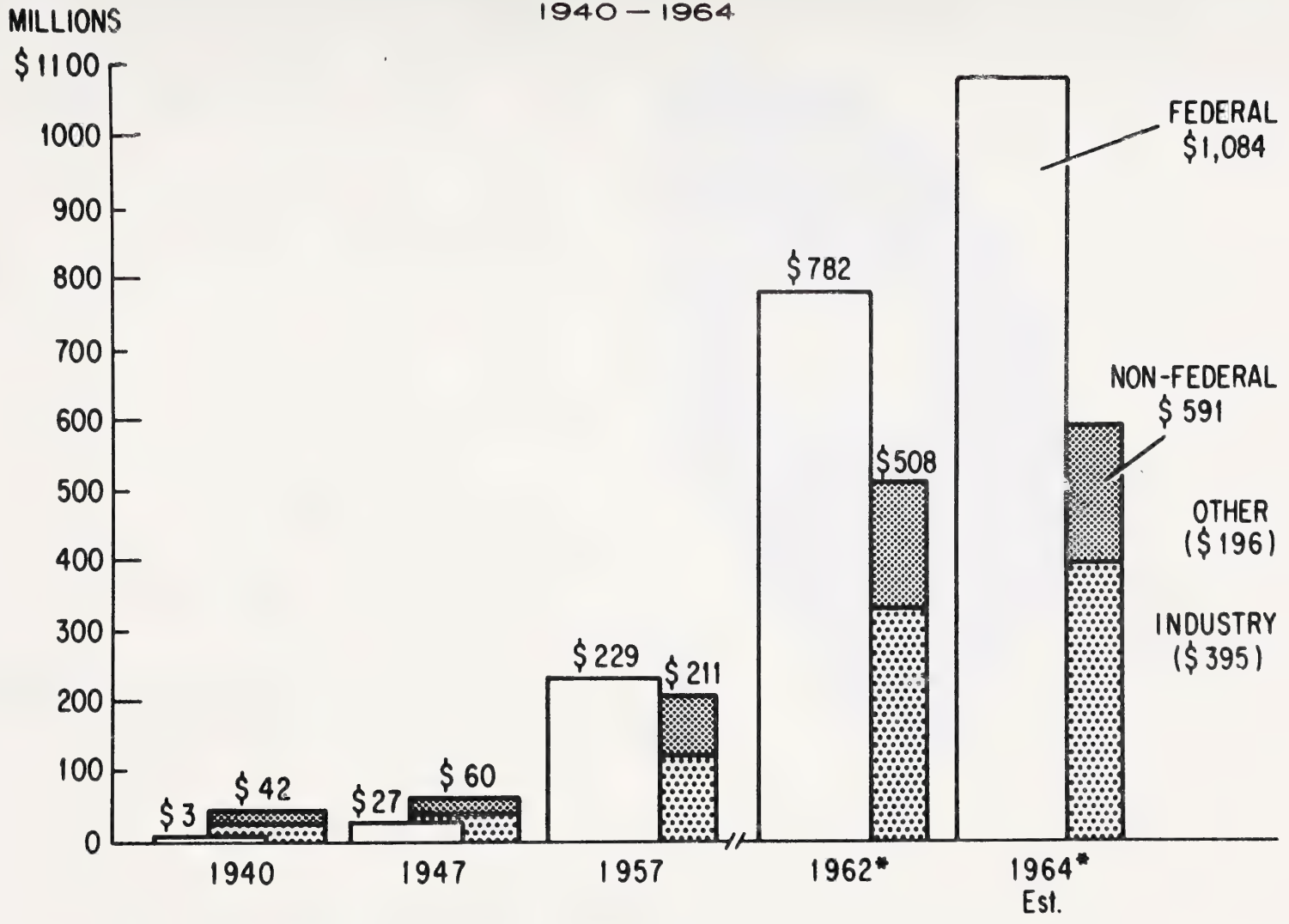


Chart 3

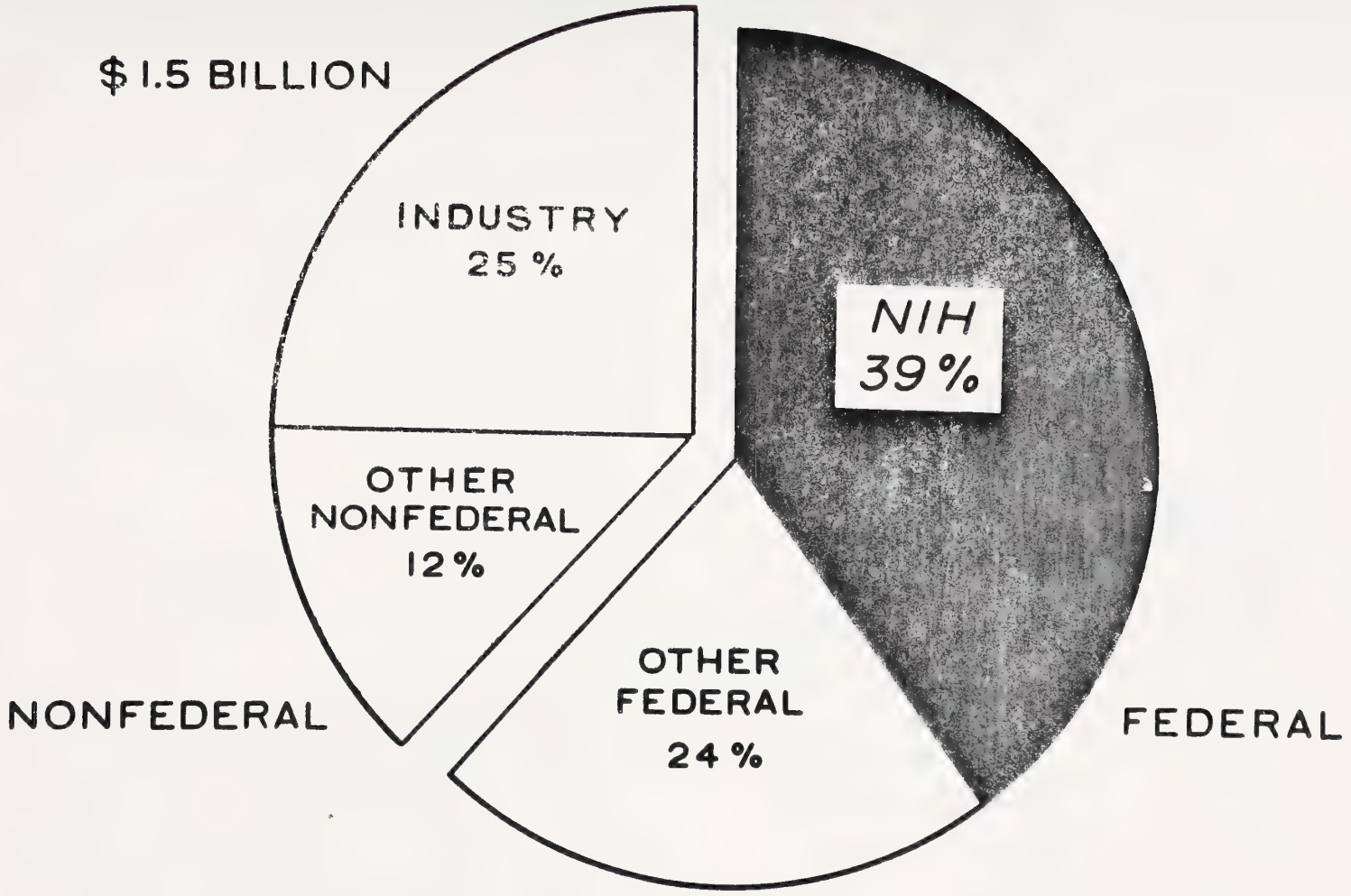
SOURCES OF MEDICAL RESEARCH FUNDS

1940 — 1964



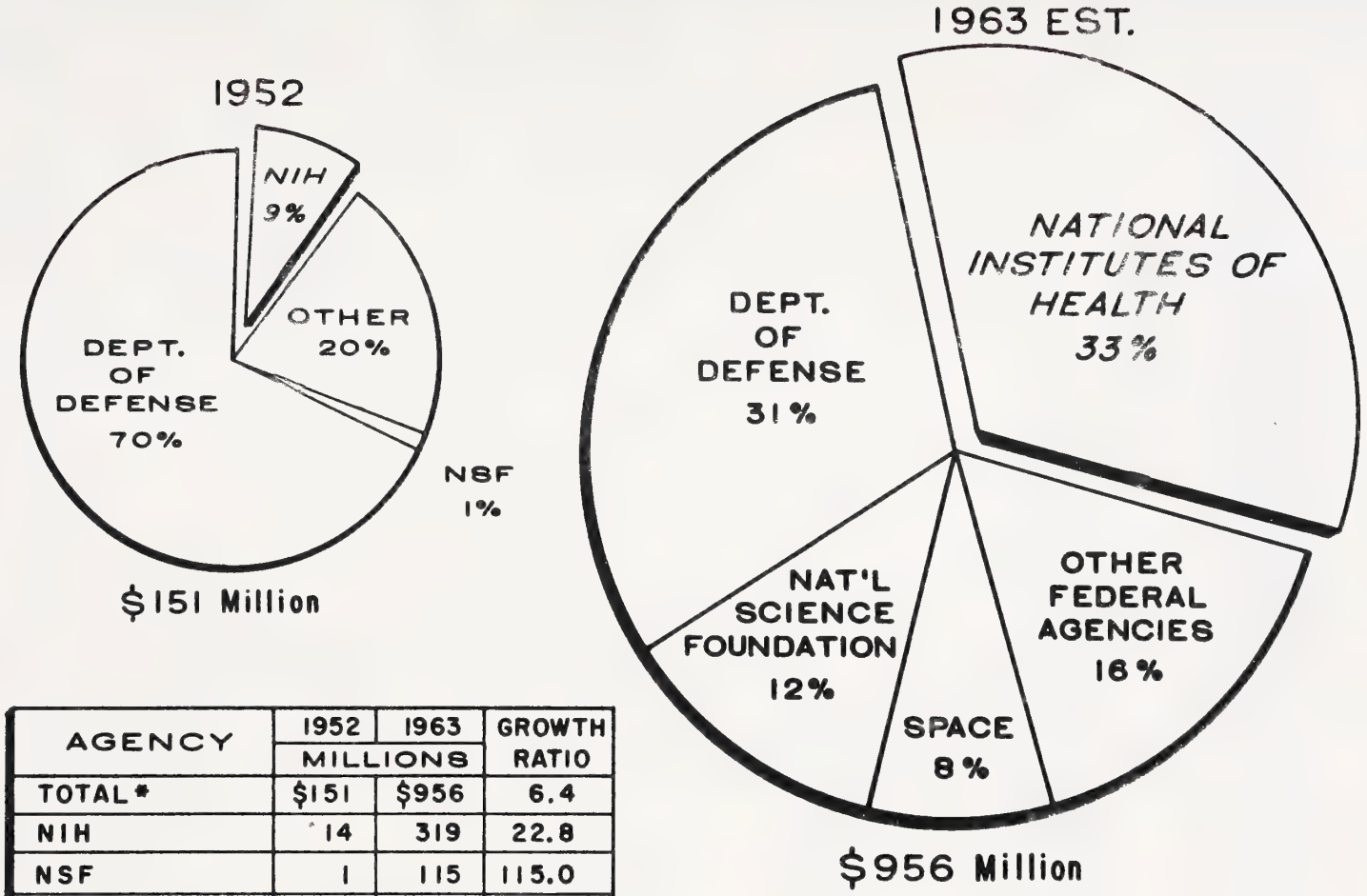
*Non-Federal data not strictly comparable with those for prior years, since coverage has been improved.

NIH FUNDS AS A PROPORTION OF NATION'S MEDICAL RESEARCH SUPPORT



Chart

TRENDS IN FEDERAL SUPPORT OF RESEARCH AT COLLEGES AND UNIVERSITIES 1952 - 1963



AGENCY	1952	1963	GROWTH RATIO
	MILLIONS		
TOTAL*	$151	$956	6.4
NIH	14	319	22.8
NSF	1	115	115.0
Defense	106	296	2.8
Other Federal†	30	226	7.5

* Excludes university managed Federal contract research centers, such as Los Alamos, Argonne, and Jet-Propulsion Laboratory.

† Includes National Aeronautics & Space Administration.

HALF OF NIH RESEARCH GRANT FUNDS GO TO MEDICAL SCHOOLS, HALF TO OTHER INSTITUTIONS

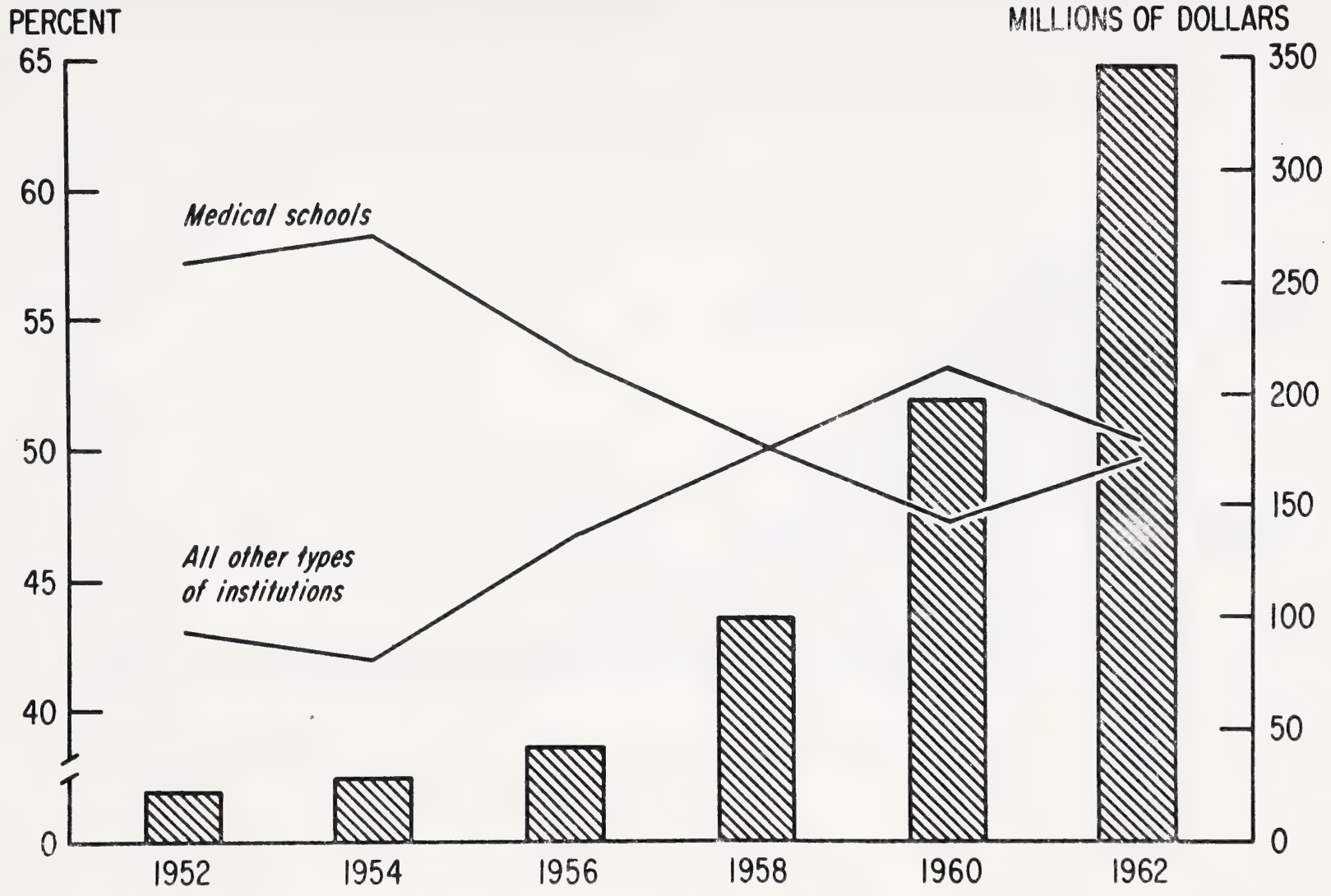
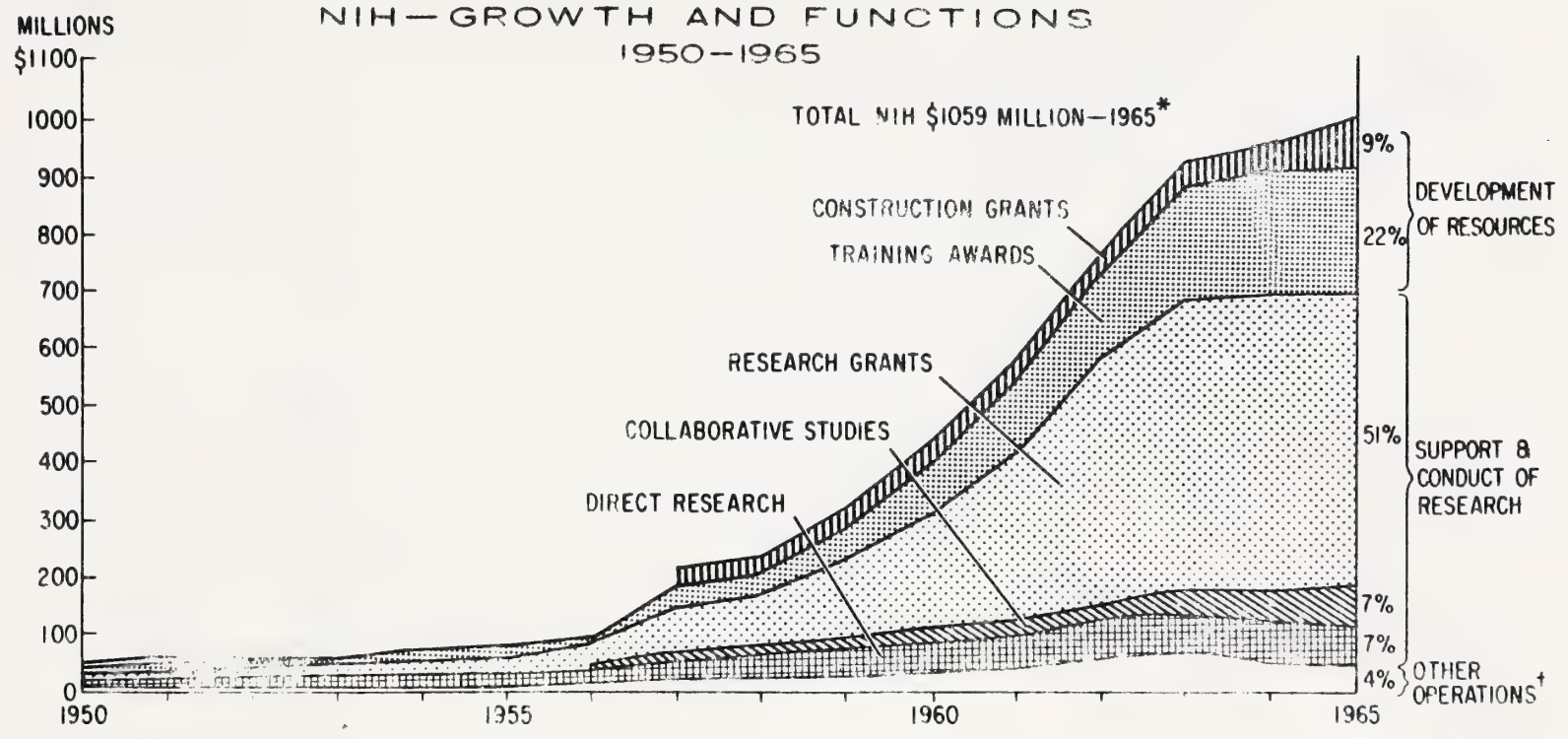
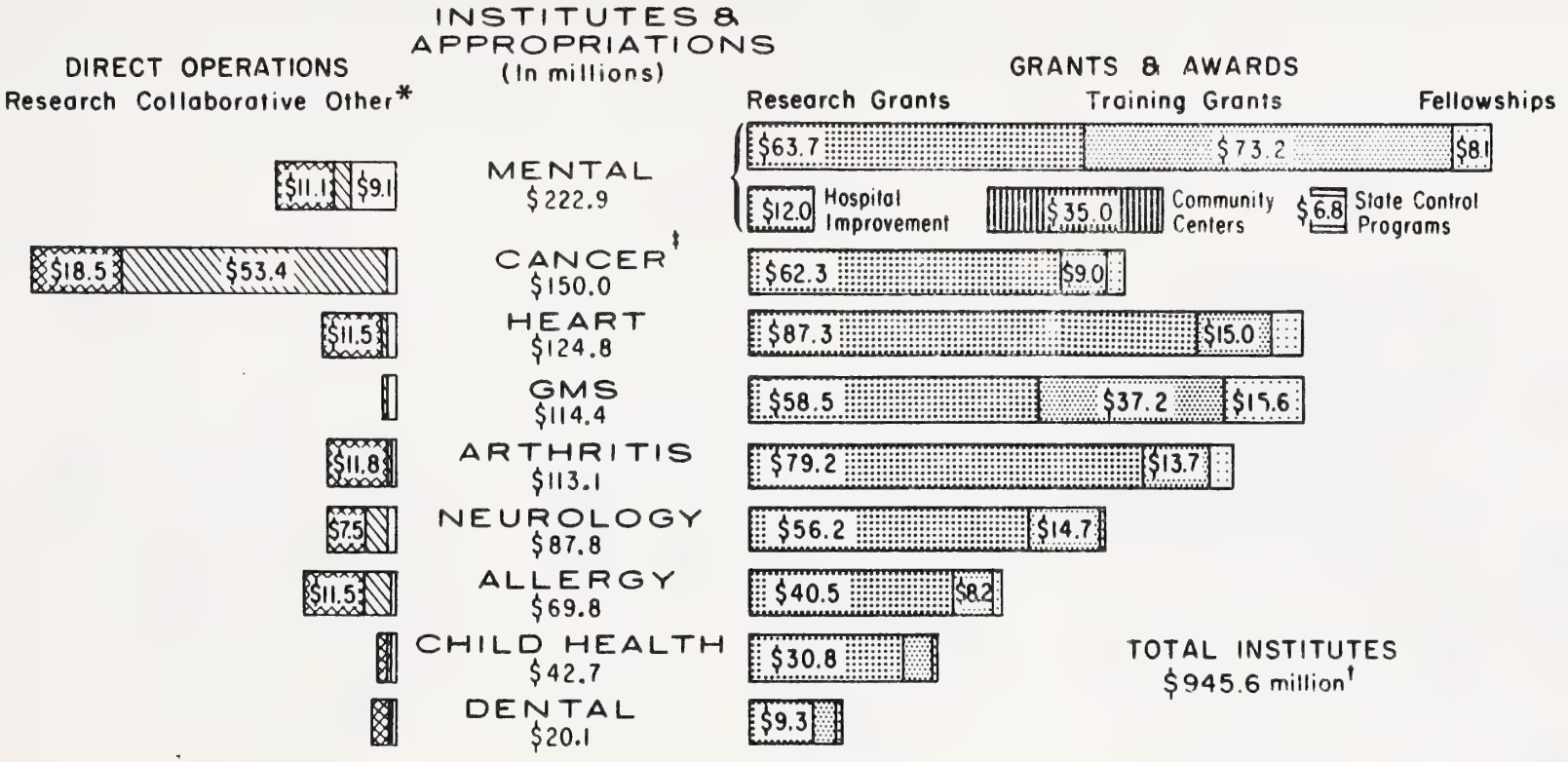


Chart 7



*Excludes direct construction. †State control programs (Mental Health only for 1964 and 1965), professional and technical assistance, training, program direction, review and approval, biologics control

PROGRAMS OF THE 9 INSTITUTES, 1965

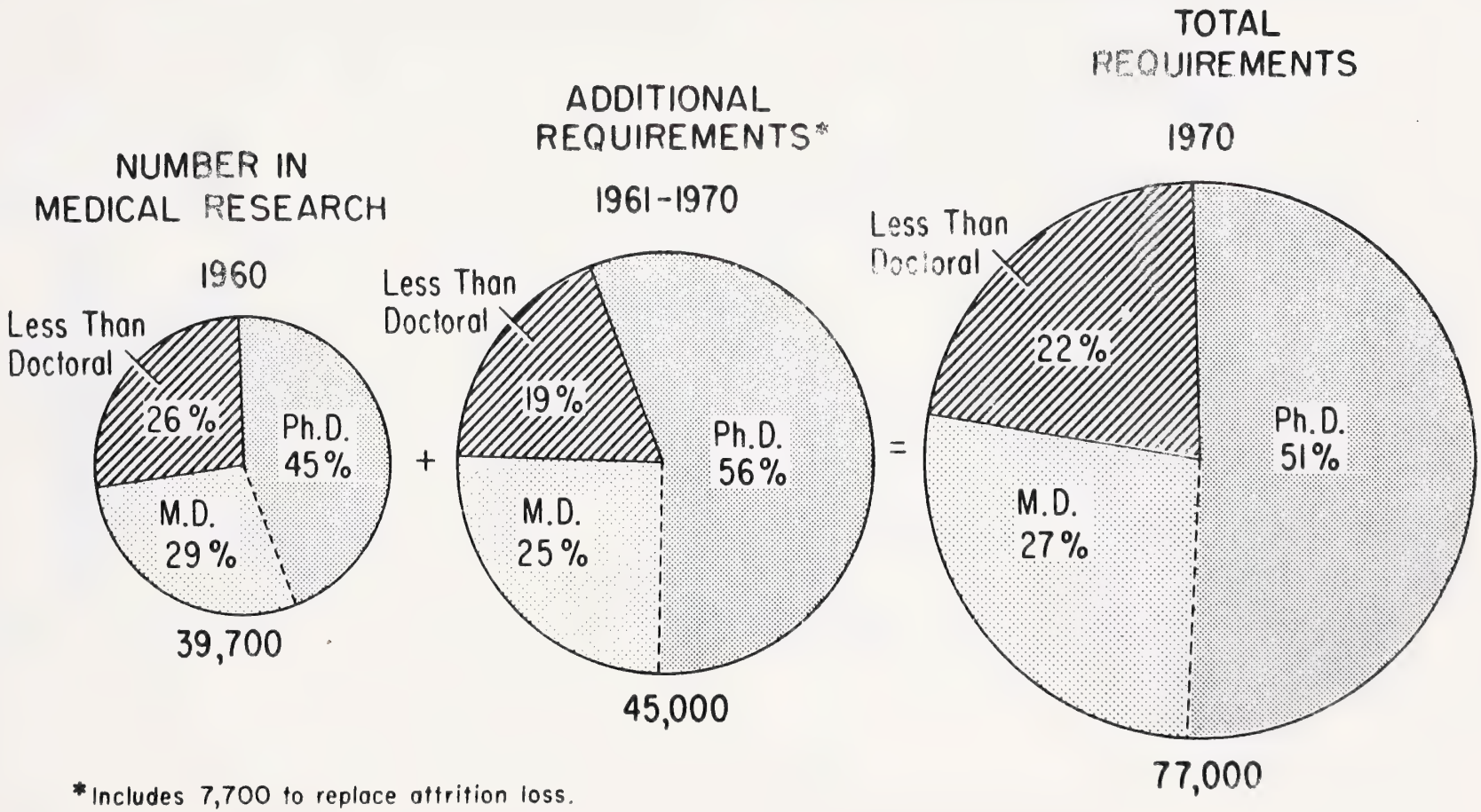


*Training, professional and technical assistance, review and approval, and program direction.

†Does not include appropriated amounts for DBS $5.0, OIR $5.5, DRFR $102.8, or direct construction.

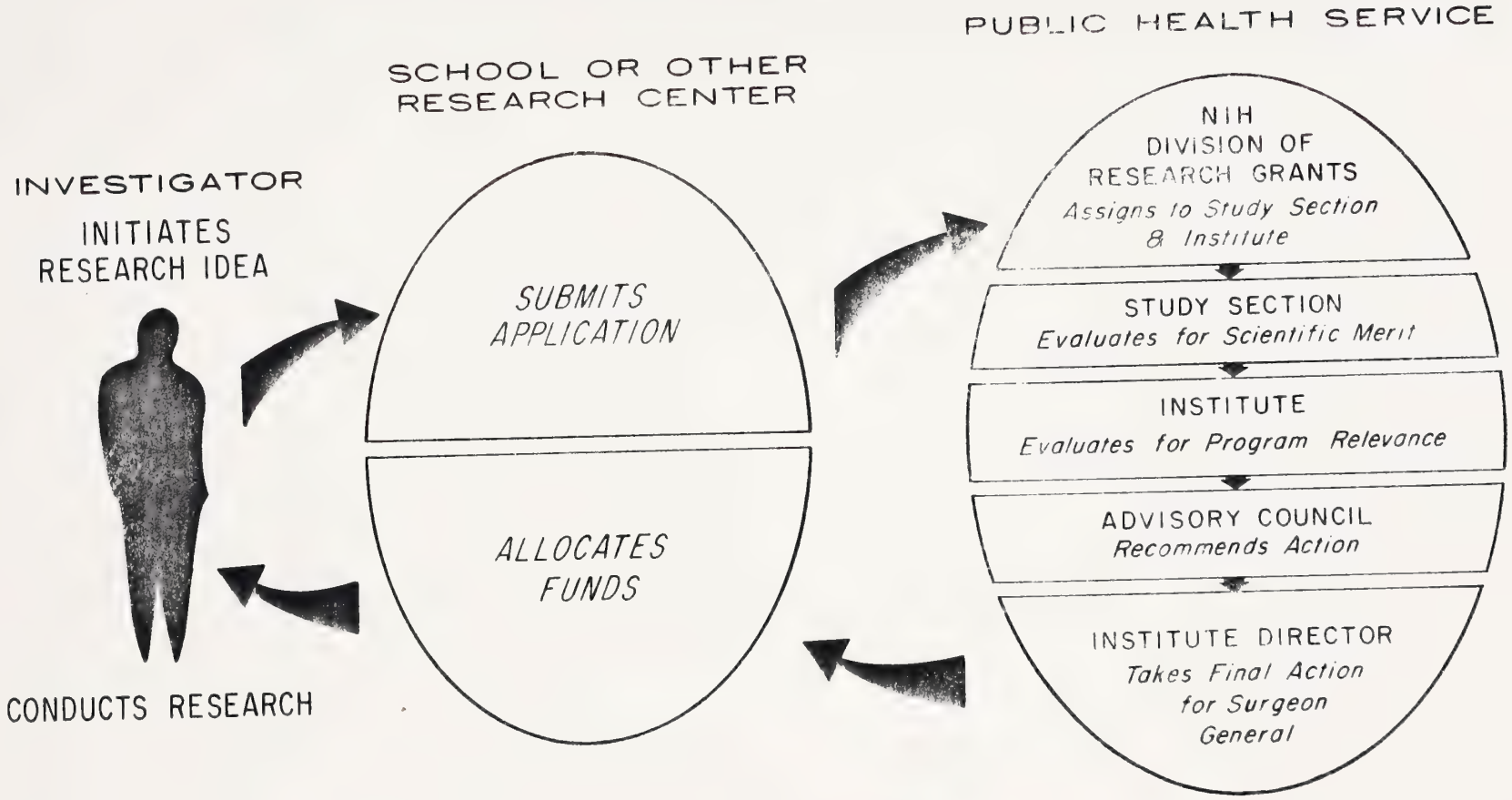
‡Contains $10.0 million for virus cancer research.

MANPOWER FOR NATION'S MEDICAL AND HEALTH-RELATED RESEARCH BY DEGREE 1961-1970



*Includes 7,700 to replace attrition loss.

HOW A RESEARCH GRANT IS MADE



TAB 46

361 Hea
Dr. Shannon
2/16/65

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Statement by Director, National Institutes of Health
Public Health Service

on

1966 Appropriation Estimates

Mr. Chairman and members of the Committee:

I have always felt it to be one of my more congenial duties to appear before this Committee to report to you on the progress of the national effort in health research, to give an account of NIH stewardship in administering Federal support for biomedical research and to outline the future needs of the program as I see them. This is the tenth occasion on which I have had this privilege and I am therefore especially mindful today of the role which this Committee has played in stimulating medical research. The tremendous growth in the scope and substance of the NIH programs during the past ten years owes much to Congressional recognition of the importance and urgency of health research.

Before proceeding further with my prepared statement, Mr. Chairman, it might be appropriate if I were to act on your suggestion and sketch out, for the benefit of the new members of this Committee, the background of the NIH programs, and their relationship both to the total national medical research effort and to the role which the Federal Government plays in its support.

[Extemporaneous description of NIH programs and their role]

I should like to talk for a few minutes about the direction in which biomedical research seems to be moving and the role which Federal support programs--and the NIH programs in particular--might most usefully play in the years immediately ahead. I should then like to discuss some of our administrative problems and comment on the salient features of the NIH budget request that is now before you.

The growth that has taken place in medical research involves much more than the increase in the size of the expenditure for its support of the number of people actively engaged in it. It has been a growth in the true biological sense of development. The medical research effort today is not merely larger than it was ten years ago, it is also more mature--in character, in outlook and in capabilities. The change that has taken place is, in fact, as significant as the transition from adolesence to adulthood.

The biomedical research community in this country is now quite clearly entering a new phase which involves dramatic changes in its concepts concerning some of the major biological and disease problems, in the substance of the investigations it undertakes, in the tools and methods which it uses and in the social and economic framework within which it works.

Biology is the most complex of the sciences and, because it involves life itself, the most difficult field for experimentation. It has therefore lagged behind the other sciences in reaching a

comparable stage of maturity. Progress along the broad frontier of science is never uniform and major advances take place, successively, in one or the other of its principal disciplines. Chemistry, for example, made tremendous strides during the 1920's and 1930's; physics was clearly the dominant science of the 1940's and 1950's. There is reason to believe--and certainly much reason to hope--that in the 1960's we have entered what may come to be called the age of biology.

New knowledge, new techniques and, which is even more important, new ideas are changing the structure of biology as a science, are amplifying the power of medicine to deal with the problems of sickness, disability and premature death, and will in the foreseeable future alter the patterns of preventive and therapeutic medicine.

These changes will require comparable changes in the collective community involvement in biomedical research, training and services of which the Federal support programs are an increasingly important feature. Scientific progress and societal support are reciprocal factors: as science progresses it makes more demands on society; as society broadens its support, science is able to progress more rapidly.

During the past ten years the NIH extramural programs have been primarily designed, on the one hand, to stimulate and support the work of individual investigators and, on the other, to build up the national capability for research. To the latter end we have been

concerned with research-training, primarily at the graduate levels; with early support for promising young investigators; with the construction and equipping of more adequate research facilities; and, in recent years, with the creation of new forms of integrated research organizations.

These efforts have been outstandingly effective. No one who has watched the development of biomedical research during the past decade can fail to be impressed by its progress. There has been rapid and steady acceleration in the expansion of research capability; in broadening the scope of attack both on basic biological questions and on disease problems; in the pace of research productivity and achievement; and in heightening the quality of the work done.

The lack of facilities and experienced research personnel is no longer the seriously limiting factor on the expansion of research that it was up to a very few years ago. Thanks in no small measure to the consistent interest of the Congress, this country now has varied and flexible means for biomedical research which, if existing programs are vigorously maintained, will continue to gain in strength and versatility. In other words, we need no longer be primarily concerned with laying the foundations for research--the main thrust of our efforts can now be devoted to mounting the comprehensive and massive attacks on disease problems and related basic research for which these foundations were designed.

This is not to say that we shall no longer be concerned with broad national needs for new resources and new facilities both for research and for training. The needs of graduate education in the biological sciences, in particular, are far from being met. We should, for example, stimulate and assist the new medical schools that are now coming into being to include in their plans adequate resources for graduate education. But, on the whole, we may now turn our attention to problems of balance and adaptability to changing opportunities. This will require us to become more selective in expanding our support programs.

The directions in which Federal support for biomedical research should move must be related to an overall national plan and purpose which, on one side, encompasses activities in the prevention, diagnosis and treatment of disease and, on the other side, includes undergraduate, graduate and professional education and the whole gamut of scientific research activities.

Within this broad context, NIH plays a dual role. By its organizational position as a bureau of the Public Health Service and the legislative language creating the various Institutes, NIH is properly described as a health organization using scientific research for the futherance of its particular health mission. At the same time, however, because of the nature of its activities and its special relationships with the academic community, NIH can also be regarded as a scientific research organization which has the

special mission of concerning itself with health problems. In its role as a health organization, NIH is an important adjunct to health service activities and, as its preoccupation with the creation of a research base recedes, it should be able to give more attention to the need to provide a better link between research results and their practical application. In its role as a scientific research organization, NIH has a significant involvement with university science departments and, as the science base of medical research broadens, NIH will inevitably be increasingly involved in the activities of a wider circle of the scientific community. These two spheres of interest are not necessarily in conflict but they do present problems of balance and seem likely, in the future, to complicate the task of effective policy and program development.

The substance of science with which medical research must be concerned has expanded to a point where the traditional clinical disciplines no longer dominate the scene. Some of the most promising and productive work is today being done in fields that sprawl across the neat categories into which academic science has long been divided. The foresight of the Congress in providing support for a very broad range of fundamental research and training relevant to the health sciences has played a large part in fostering this widening of the thrust of biomedical research.

An outstanding example of the 'new look' in medical research is the move towards the intensive study of human development--viewing man as a single complex unit and his progression from conception to death as a single consequential continuum. There is ample reason to believe that such an integrated approach will not only shed fresh light on the origin, causes and courses of some diseases and disabilities but that it can make unique contributions to preventive medicine and to the solution of congenital and environmental health problems.

There are exciting opportunities and provoking challenges on many biomedical research frontiers.

Developments in the field of molecular biology have the most fundamental implications for medicine. It has been suggested--and it is no exaggeration--that its ultimate effects on the practice of medicine will be as revolutionary as the discovery only a hundred years ago that diseases could be caused by germs.

The door to the inner workings of genetics has been pried open by such brilliant young scientists as Dr. Nirenberg of the National Heart Institute. We know enough to be reasonably sure that the intricate mechanisms controlling heredity also control--or at least influence--some aspects of the functioning of the organism throughout its life, probably including its predisposition to contract certain diseases. Much difficult work remains to be done--and, I may say, many

inspiring hunches will be needed--before we have a sufficient understanding of the genetic process to be able to apply our knowledge to the prevention or cure of congenital disabilities or weaknesses. But the rewards of success appear to be so promising that this field merits close attention and consistent support.

Although man has reproduced himself since the beginning of the species, the process by which this is accomplished is still so little understood that science is not prepared to give definitive answers to many of the urgent questions that now arise in connection with population control.

The Committee has during the past few years heard much testimony concerning the ubiquitous role that viruses may be playing in a wide range of diseases not heretofore suspected of having a viral origin. The apparent ability of viruses to continue to affect their host even after they seem to have disappeared not only indicates the difficulties encountered in virus research but also illustrates how a research pursuit can be frustrated simply by the lack of techniques for keeping the culprit in sight.

A beginning is now being made on the systematic study of environmental poisons--not only water pollution and air pollution but the cummulative affects of all kinds of chemicals and drugs which we breathe, swallow or touch in the course of our normal activites. The finger of suspicion has been pointed at some of these compounds not only as possible causes of disease but as having effects transmittable to our offspring.

While drugs are under surveillance for their possible dangers, the range of their effectiveness in the cure and alleviation of disease is constantly widening. This is particularly true in psychopharmacology which now holds out the hope that we may in the not too distant future be able to release a high proportion of the inmates of our mental institutions.

The behavioral sciences are becoming a significant concern of medical scientists, as it is increasingly recognized that man reacts--physiologically as well as psychologically--to all aspects of his environment. As this Committee is well aware, juvenile delinquency is, in a sense, a disease--like alcoholism, drug addiction or overeating. The line between the medical sciences and the behavioral sciences is disappearing in many areas and medical research is again taking as its province the attainment of the Roman ideal of "Mens sana in corpore sano"--a sound mind in a sound body.

A common feature of all these areas into which some of the major thrust of medical research is shifting is that they cut across the traditional categorical lines. It is already quite clear that much of the research effort of the future will be focused on fundamental biological processes whose disturbance (as, for example, by a virus) or malfunction (due, perhaps, to a genetic deficiency) results in a condition we recognize as a disease. Physicians have long known that treatment of the symptoms of a disease must, if possible, be accompanied

by treatment to remove its cause. Medical scientists similarly recognize that research focused on a disease must be accompanied by research into the biological process which underlies it. Research which starts with a normal biological process and explores the aberrations that result in disease is no less important to the advancement of medical knowledge--and is sometimes less difficult--than research which starts with a disease and seeks its causes. To achieve a proper balance between these two approaches must be one of our main concerns.

Another common feature of current developments in medical research is its increasing reliance--or even dependence--on methods, tools and techniques not traditionally associated with biology and medicine. Highly effective use is made--though still by too limited a circle of investigators--of concepts and instrumentation borrowed or adapted from the physical sciences. The instrumentation developed by physicists is far more sophisticated and refined than that in common use in medical research. Automation offers possibilities for routine laboratory and even clinical procedures which are only beginning to be explored.

The translation of biological phenomena into mathematical models presents a powerful tool for their systematic explorations--especially now that computer technology has made it feasible to perform extensive series of very complicated mathematical computations. The difficulty in this area is that there are, as yet, so few mathematical

generalizations in biology. There are so many variable factors and their relationships are so complex that it is extremely difficult to state them in mathematical terms. The work requires the combined efforts of biomedical scientists with a flair for understanding analogous mathematical concepts and mathematicians with a flair for understanding biological problems. Such teams are not easy to organize but can be most effective.

The creation of a Division of Computer Research and Technology at NIH is a significant step in our efforts to being the precise techniques of mathematics and the capabilities of data processing machines to bear on the solution of biomedical problems. This Division and the National Heart Institute are in process of installing an experimental computation-data conversion system in the Clinical Center which should make it possible to examine systematically and to relate a large volume of data derived from instruments used in physiological experiments. The Division is also working with the Clinical Pathology Department of the Clinical Center is pioneering automatic handling of laboratory data and its rapid correlation with existing data. One of the most important functions of the Division, however, will be to bring biological and medical scientists into close personal contact with sophisticated mathematical, engineering, and systems competence. The new Division will provide our intramural scientists with a new and powerful tool but the training it will provide

not merely in the mechanics of computer technology but in the underlying mathematical concepts may well be an even more important contribution to the long-range development of biomedical research.

There is also considerable scope in medical research for investigators with engineering talents. The medical application of miniaturized electronic equipment needs to be further explored and there are opportunities for mechanical and materials engineers. It should, for example, be possible to develop a cheap and effective plastic mold to replace the heavy and clumsy plaster casts which are still used to immobilize certain parts of the body.

A third feature of the changing methodology of medical research is the increased use of epidemiological studies and selective population surveys. These efforts, which can yield highly valuable results unobtainable through normal laboratory research or clinical investigation, often require the cooperation of statisticians, sociologists, social anthropol gists and, sometimes, even economic historians.

I have tried to sketch very briefly some of the ways in which biomedical research is changing its complexion. Federal support for this research must recognize these changes and make allowance, within the terms of national policy, for meeting the changing requirements.

One of the characteristics of research is that its costs usually increase as it matures. Each of the directions in which biomedical research is moving and the developmental programs which

will be necessary to incorporate research achievements into diagnostic and therapeutic practices will be costly. It must be expected that these costs will increasingly be reflected in future appropriation requests.

The management of Federal programs to support health-related research or to facilitate its application to health services must take careful account of their impact on the participating institutions. These institutions usually have important functions and responsibilities that lie outside the fields with which the Federal programs are concerned. It is essential that they retain full responsibility for the management of their own affairs--that they have control over their education, research, and service activities; are free to implement their own plans for institutional development; and have first call on the professional loyalty of their faculty and staff. Special care must be taken to ensure that the expansion of facilities and growth of institutional activities stimulated by the Federal Government will take a form which will strengthen, rather than weaken, the total program, the organizational integrity, and the unique character of each institution.

As you know, Mr. Chairman, some of the NIH programs--such as the institutional grants--are specifically designed to strengthen participating institutions while many others--including the various kinds of center grants--are implemented in a way that will have this effect.

We also hope to develop administrative procedures which will give grantee institutions a more realistic role in the management of grant-supported projects. A pilot study is now underway in which responsibility for changes in project budgets or uses of grant funds, which normally require prior approval by the Public Health Service, has been delegated--with suitable guidelines--to the executive echelon of seven of the largest grantee institutions [the Massachusetts General Hospital, Massachusetts Institute of Technology, Columbia University College of Physicians and Surgeons, Rockefeller Institute, University of Pennsylvania, Johns Hopkins University School of Medicine, and the University of Michigan]. The items covered by this arrangement are expenditures for office equipment, laboratory equipment costing more than $1,000, travel, hospitalization of patients, publication of books and monographs, tuition charges, and alterations or renovation up to a limit of $2,500. One of the purposes of the pilot study--which will be evaluated at the end of a year--is to develop procedures for assisting other institutions to improve their grants management. We believe that placing administrative authority for decisions of this kind in the hands of responsible administrators who are closest to the research activity, will not only improve the administration of grant funds but will better serve the scientific aims of the grant projects.

In giving increased attention to the institutional aspects of our support programs we are not, of course, losing sight of the importance of the individual grantees. Research is done by investigators--not by institutions or their administrators. The traditional NIH project grants must continue to be a major element in our program.

Any comprehensive assessment of the projects supported by NIH grants will show--as several recent reviews have, in fact, shown--that the quality of the research done has remained impressively high. There has, very properly, been concern--in the Congress, in the scientific community, in the Executive Branch and, indeed, at NIH itself--that the rapid expansion of the Federal support programs might lead to lower standards for the work considered eligible for support. I am certain, Mr. Chairman, that the overall quality of research has not merely been maintained but has risen significantly as a direct result of the expansion of the project grant programs.

I am happy to say that the quality of the work done by our grantees is fully matched by our intramural staff.

The maintenance of the stature of NIH as one of the outstanding research institutions in this country--and, indeed, in the world--is, of course, of great importance to the national medical research effort. The highly-qualified and dedicated scientists and technical staff who work in the Clinical Center and the NIH laboratories

in Bethesda, in Montana, in Panama, in Ghana, in Pakistan and, on special assignment, in other laboratories around the world are making significant contributions to the progress of biomedical science and its success in the constant battle against the onset and effects of disease. That these contributions are widely recognized and respected is shown by the awards and honors which NIH scientists continue to receive. For example, Dr. Marshall Nirenberg, who has already been widely honored for his major contribution to the understanding of the mechanics of genetics, was one of eleven scientists to whom the President awarded the National Medal of Science. The Bolivian Government has named a hospital and erected a bronze statue in memory of the late Dr. Henry K. Beye who, as director of the Middle American Research Unit, led the fight against Bolivian hemorrhagic fever. Dr. Willy Burgdorfer, of the Rocky Mountain Laboratory, received a John Simon Guggenheim Memorial fellowship for his distinguished work on viral and rickettsial infections.

I should like, if I may, Mr. Fogarty, to place in the record a listing of the awards received by members of the NIH scientific staff for the outstanding job they are doing.

The quality of the intramural research at NIH is equally important to the maintenance of the quality of the extramural programs. This works in two ways. The presence on the Bethesda

campus of a cross-section of clinical investigators and bench scientists who are working in the forward areas of the research frontier makes it possible for those responsible for the direction of the extramural programs to keep abreast of new research developments, to spot new research opportunities, and to anticipate future research trends. In a field which is developing as rapidly as biomedical research and which involves so many scientific disciplines and specialties, this relationship is essential to sensitive and responsive policy development and program management. The fact that this relationship exists at NIH and the acknowledged standing of NIH as a first-class research institution also serves,in a subtle but very real way, to make the biomedical research community more responsive to NIH leadership in developing national programs.

I am, however, very much worried, Mr. Chairman, about our ability to maintain high standards of scientific and administrative competence by the difficulties we have encountered in recruiting senior staff. The sort of persons we should like to have to develop new concepts and new approaches in an extremely broad and complex research area, can command much higher salaries--and with more attractive fringe benefits--in an academic institution than we are able to offer. The salary handicap is, for example, seriously affecting our ability to staff the new Division of Computer Research and Technology.

The effectiveness and viability of the NIH role in biomedical research--and, therefore, to a very large extent, the effectiveness of the whole national health research effort--will be significantly influenced by the quality of the professional staff in both the intramural and extramural programs. It is therefore essential that we should be able to recruit staff who not only have outstanding scientific and administrative competence but the vision to see the opportunities that lie ahead, the imagination to design fresh approaches to exploit those opportunities and the qualities of leadership necessary to insure that those approached are vigorously pursued.

The budget estimates for the Institutes and operating Divisions of NIH total $1,040,056,000. This amount represents an increase of $74 million, or about 7 percent, over the expected operating levels for the current year.

This budget, together with the funds that have been separately requested for Health Research Facilities Construction, direct construction, and the international activities using P.L. 480 funds, provides for a third year of restrained and selective growth following seven years of extraordinarily rapid expansion of the programs. The increases requested are focused on specific targets in areas of science in which progressive expansion seems most desirable--such as gerontology, child health, and toxicology.

An increase of $25 million--or about 6 percent--is requested for regular research project grants. Of this amount, approximately $19 million will enable us to meet commitments for the support of existing research projects (that is, noncompeting continuations). The other $6 million is requested to bring indirect cost payments by NIH into line with the current practice of other Federal grant-making agencies.

Increases totaling $18 million--or a little over 15 percent--are requested to strengthen the special research programs. Clinical research and special resource centers are playing an increasingly important part in extending this country's research capabilities to meet the challenges and exploit the opportunities that lie before us. The budget contains $57 million for these programs--an increase of $9.5 million, or nearly 17 percent, over their present level. The budget also includes an additional $6 million for the further expansion of the special grant program of the National Institute of Mental Health for hospital improvement. This program was started in fiscal year 1964 with an allocation of $6 million; the current allocation is $12 million; it is requested that $18 million be provided for fiscal 1966 for this important step in increasing the effectiveness of the treatment of mental illness.

Two new programs focused on areas in which there is both a great public need and a great scientific opportunity are included in the budget now before you. One is a request by the National Cancer Institute for $1.5 million to set up child leukemia centers. No cure for this tragic disease has yet been found but the curtains of mystery hiding its cause seem to be parting. The proposed centers will materially assist in accelerating leukemia research. The second new budget item is the proposal of the National Institute of General Medical Sciences to launch a program aimed at creating new resources for research and associated training in the fields of toxicology and pharmacology. As this Committee pointed out in its report on last year's appropriation bill, these two fields represent a deficiency in the NIH research programs--especially in the light of mounting evidence that prolonged exposure to many chemicals and drugs now common in our environment may have long-term effects on health and, possibly, on heredity. The budget includes $1 million for this program.

The budget includes an increase of a little over $19 million--or about 8-1/2 percent--for the fellowship and training grant programs. Over half of this increase is in the training grant programs of the National Institute of Mental Health. The major increases among the other Institutes are: a little over $3.6 million for the National Institute of General Medical Sciences (of which $1 million is for predoctoral fellowships); exactly $2 million for the National Institute

of Child Health and Human Development; and about $1.5 million each for the National Institute of Arthritis and Metabolic Diseases and the National Institute of Allergy and Infectious Diseases.

Considered by activity, two-thirds (or more than $13 million) of the requested increases for fellowships and training are to permit the funding of 165 additional graduate training grants bringing the total of these vitally important training projects to 3,373. A substantial increase--about $4 million or nearly 23 percent over the current appropriation--is also sought for Research Career Development awards. This program, launched in fiscal year 1962, has amply demonstrated its effectiveness. The increase requested will permit 166 additional awards bringing the total number of current awards to 1,119.

The increases requested in the budget now before you are modest but they will enable us to maintain the momentum of the present programs. It is, however, a tight budget with no slack in any of its components. It is, therefore, important that we have some flexibility in administering the NIH appropriations. Unforeseen developments are a normal feature of effective research, Mr. Chairman. In fact, if there were no unforeseen developments in the program of a research institution, I would begin to suspect that the institution was stagnating or doing very routine work. A vigorous research organization playing a major national role in a period of rapid scientific

developments cannot function as effectively as it should if it is bound too tightly to the details of budget estimates prepared twelve to eighteen months in advance.

The degree of flexibility necessary can be achieved by the provision, in the Bill now before you, authorizing the transfers up to 5 percent between NIH appropriations and by the removal of present limitations on reallocations within each of these appropriations. I should like to urge the Committee to give its most sympathetic consideration to these two requests.

During the past year there have been a number of changes among the directors of the Institutes and Divisions who will testify on the details of the various budget estimates.

Dr. Robert H. Felix has been succeeded as Director of the National Institute of Mental Health by Dr. Stanley F. Yolles. Dr. Yolles joined the staff of the Institute in 1954. He became Associate Director for Extramural Programs in 1960 and for the past year and a half has been its Deputy Director.

Dr. Clinton C. Powell, the first Director of the new National Institute of General Medical Sciences, has been succeeded by Dr. Frederick L. Stone who has been associated with the NIH extramural programs since 1958 including four years as Assistant Chief of the former Division of General Medical Sciences. He became Chief of the Division of Research Facilities and Resources when that was created in 1962. For the time being, Dr. Stone will continue to act in the latter capacity also.

Dr. Justin M. Andrews, the director of the National Institute of Allergy and Infectious Diseases, has retired. The new director is Dr. Dorland J. Davis who has been the Institute's Associate Director for Intramural Research since 1956.

Dr. Charles V. Kidd has been succeeded as Chief of the Office of International Research by Dr. Charles L. Williams, Jr., who has been Associate Director for International Relations in the Office of International Health in the Office of the Surgeon General.

I shall, of course, be happy to answer any questions which the Committee may have.

Thank you, Mr. Chairman.

TAB 47

362
Mr. Shannon
3/15/65

DEPARTMENT OF HEALTH, EDUCATION AND WELFARE

Statement by Director, National Institutes of Health
Public Health Service

on

1966 Appropriation Estimates

Mr. Chairman and members of the Committee:

I have always felt it to be one of my more congenial duties to report to this Committee on the progress of the national effort in health research, to give an account of NIH stewardship in administering Federal support for biomedical research and to outline the future needs of the program as I see them. This is the tenth occasion on which I have had this privilege and I am therefore especially mindful of the role which this Committee has played in stimulating medical research.

The tremendous growth in the scope and substance of the NIH programs during the past ten years owes much to Congressional recognition of the importance and urgency of health research. I need not describe to you the effect these programs have had on medical research in this country and, indeed, abroad. The facts are well known to the members of this Committee.

I shall address myself to the future rather than to the past and discuss the direction in which biomedical research seems to be moving and the role which Federal support programs--and the NIH programs in particular--might most usefully play in the years immediately ahead.

The growth that has taken place in medical research involves much more than the increase in the size of the expenditures for its support of the number of people actively engaged in it. It has been a growth in the true biological sense of development. The medical research effort today is not merely larger than it was ten years ago, it is also more mature--in character, in outlook and in capabilities. The change that has taken place is, in fact, as significant as the transition from adolescence to adulthood.

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During the past ten years the NIH extramural programs have been primarily designed, on the one hand, to stimulate and support the work of individual investigators and, on the other, to build up the national capability for research. To the latter end we have been

concerned with research-training, primarily at the graduate levels; with early support for promising young investigators; with the construction and equipping of more adequate research facilities; and, in recent years, with the creation of new forms of integrated research organizations.

These efforts have been outstandingly effective. No one who has watched the development of biomedical research during the past decade can fail to be impressed by its progress. There has been rapid and steady acceleration in the expansion of research capability; in broadening the scope of attack both on basic biological questions and on disease problems; in the pace of research productivity and achievement; and in heightening the quality of the work done.

Thanks in no small measure to the consistent interest of the Congress, this country now has varied and flexible means for biomedical research which, if existing programs are vigorously maintained, will continue to gain in strength and versatility. In other words, we need no longer be primarily concerned with laying the foundations for research--the main thrust of our efforts can now be devoted to mounting the comprehensive and massive attacks on disease problems and related basic research for which these foundations were designed.

This is not to say that we shall no longer be concerned with broad national needs for new resources and new facilities both for research and for training. The needs of graduate education in the biological sciences, in particular, are far from being met. We should, for example, stimulate and assist the new medical schools that are now coming into being to include in their plans adequate resources for graduate education. But, on the whole, we may now turn our attention to problems of balance and adaptability to changing opportunities. This will require us to become more selective in expanding our support programs.

The directions in which Federal support for biomedical research should move must be related to an overall national plan and purpose which, on one side, encompasses activities in the prevention, diagnosis and treatment of disease and, on the other side, includes undergraduate, graduate and professional education and the whole gamut of scientific research activities.

Within this broad context, NIH plays a dual role. By its organizational position as a bureau of the Public Health Service and the legislative language creating the various Institutes, NIH is properly described as a health organization using scientific research for the futherance of its particular health mission. At the same time, however, because of the nature of its activities and its special relationships with the academic community, NIH can also be regarded as a scientific research organization which has the

special mission of concerning itself with health problems. In its role as a health organization, NIH is an important adjunct to health service activities and, as its preoccupation with the creation of a research base recedes, it should be able to give more attention to the need to provide a better link between research results and their practical application. In its role as a scientific research organization, NIH has a significant involvement with university science departments and, as the science base of medical research broadens, NIH will inevitably be increasingly involved in the activities of a wider circle of the scientific community. These two spheres of interest are not necessarily in conflict but they do present problems of balance and seem likely, in the future, to complicate the task of effective policy and program development.

The substance of science with which medical research must be concerned has expanded to a point where the traditional clinical disciplines no longer dominate the scene. Some of the most promising and productive work is today being done in fields that sprawl across the neat categories into which academic science has long been divided. The foresight of the Congress in providing support for a very broad range of fundamental research and training relevant to the health sciences has played a large part in fostering this widening of the thrust of biomedical research.

An outstanding example of the 'new look' in medical research is the move towards the intensive study of human development--viewing man as a single complex unit and his progression from conception to death as a single consequential continuum. There is ample reason to believe that such an integrated approach will not only shed fresh light on the origin, causes and courses of some diseases and disabilities but that it can make unique contributions to preventive medicine and to the solution of congenital and environmental health problems.

There are exciting opportunities and provoking challenges on many biomedical research frontiers.

Developments in the field of molecular biology have the most fundamental implications for medicine. It has been suggested--and it is no exaggeration--that its ultimate effects on the practice of medicine will be as revolutionary as the discovery only a hundred years ago that diseases could be caused by germs.

The door to the inner workings of genetics has been pried open by such brilliant young scientists as Dr. Nirenberg of the National Heart Institute. We know enough to be reasonably sure that the intricate mechanisms controlling heredity also control--or at least influence--some aspects of the functioning of the organism throughout its life, probably including its predisposition to contract certain diseases. Much difficult work remains to be done--and, many

inspiring hunches will be needed--before we have a sufficient understanding of the genetic process to be able to apply our knowledge to the prevention or cure of congenital disabilities or weaknesses. But the rewards of success appear to be so promising that this field merits close attention and consistent support.

Although man has reproduced himself since the beginning of the species, the process by which this is accomplished is still so little understood that science is not prepared to give definitive answers to many of the urgent questions that now arise in connection with population control.

The Committee has during the past few years heard much testimony concerning the ubiquitous role that viruses may be playing in a wide range of diseases not heretofore suspected of having a viral origin. The apparent ability of viruses to continue to affect their host even after they seem to have disappeared not only indicates the difficulties encountered in virus research but also illustrates how a research pursuit can be frustrated simply by the lack of techniques for keeping the culprit in sight.

A beginning is now being made on the systematic study of environmental poisons--not only water pollution and air pollution but the cummulative affects of all kinds of chemicals and drugs which we breathe, swallow or touch in the course of our normal activites. The finger of suspicion has been pointed at some of these compounds not only as possible causes of disease but as having effects transmittable to our offspring.

While drugs are under surveillance for their possible dangers, the range of their effectiveness in the cure and alleviation of disease is constantly widening. This is particularly true in psychopharmacology which now holds out the hope that we may in the not too distant future be able to release a substantially higher proportion of the inmates of our mental institutions than is posssible today.

The behavioral sciences are becoming a significant concern of medical scientists, as it is increasingly recognized that man reacts--physiologically as well as psychologically--to all aspects of his environment. As this Committee is well aware, juvenile delinquency is, in a sense, a disease--like alcoholism, drug addiction or overeating. The line between the medical sciences and the behavioral sciences is disappearing in many areas and medical research is again taking as its province the attainment of the Roman ideal of "Mens sana in corpore sano"--a sound mind in a sound body.

A common feature of all these areas into which some of the major thrust of medical research is shifting is that they cut across the traditional categorical lines. It is already quite clear that much of the research effort of the future will be focused on fundamental biological processes whose disturbance (as, for example, by a virus) or malfunction (due, perhaps, to a genetic deficiency) results in a condition we recognize as a disease. Physicians have long known that treatment of the symptoms of a disease must, if possible, be accompanied

by treatment to remove its cause. Medical scientists similarly recognize that research focused on a disease must be accompanied by research into the biological process which underlies it. Research which starts with a normal biological process and explores the aberrations that result in disease is no less important to the advancement of medical knowledge--and is sometimes less difficult--than research which starts with a disease and seeks its causes. To achieve a proper balance between these two approaches must be one of our main concerns.

Another common feature of current developments in medical research is its increasing reliance--or even dependence--on methods, tools and techniques not traditionally associated with biology and medicine. Highly effective use is made--though still by too limited a circle of investigators--of concepts and instrumentation borrowed or adapted from the physical sciences. The instrumentation developed by physicists is far more sophisticated and refined than that in common use in medical research. Automation offers possibilities for routine laboratory and even clinical procedures which are only beginning to be explored.

The translation of biological phenomena into mathematical models presents a powerful tool for their systematic explorations--especially now that computer technology has made it feasible to perform extensive series of very complicated mathematical computations. The difficulty in this area is that there are, as yet, so few mathematical

generalizations in biology. There are so many variable factors and their relationships are so complex that it is extremely difficult to state them in mathematical terms. The work requires the combined efforts of biomedical scientists with a flair for understanding analogous mathematical concepts and mathematicians with a flair for understanding biological problems. Such teams are not easy to organize but can be most effective.

The creation of a Division of Computer Research and Technology at NIH is a significant step in our efforts to being the precise techniques of mathematics and the capabilities of data processing machines to bear on the solution of biomedical problems. This Division and the National Heart Institute are in process of installing an experimental computation-data conversion system in the Clinical Center which should make it possible to examine systematically and to relate a large volume of data derived from instruments used in physiological experiments. The Division is also working with the Clinical Pathology Department of the Clinical Center is pioneering automatic handling of laboratory data and its rapid correlation with existing data. One of the most important functions of the Division, however, will be to bring biological and medical scientists into close personal contact with sophisticated mathematical, engineering, and systems competence. The new Division will provide our intramural scientists with a new and powerful tool but the training it will provide

not merely in the mechanics of computer technology but in the underlying mathematical concepts may well be an even more important contribution to the long-range development of biomedical research.

There is also considerable scope in medical research for investigators with engineering talents. The medical application of miniaturized electronic equipment needs to be further explored and there are opportunities for mechanical and materials engineers. It should, for example, be possible to develop a cheap and effective plastic mold to replace the heavy and clumsy plaster casts which are still used to immobilize certain parts of the body.

A third feature of the changing methodology of medical research is the increased use of epidemiological studies and selective population surveys. These efforts, which can yield highly valuable results unobtainable through normal laboratory research or clinical investigation, often require the cooperation of statisticians, sociologists, social anthropologists and, sometimes, even economic historians.

This is a very brief sketch of some of the ways in which biomedical research is changing its complexion. Federal support for this research must recognize these changes and make allowance, within the terms of national policy, for meeting the changing requirements.

One of the characteristics of research is that its costs usually increase as it matures. Each of the directions in which biomedical research is moving and the developmental programs which

will be necessary to incorporate research achievements into diagnostic and therapeutic practices will be costly. It must be expected that these costs will increasingly be reflected in future appropriation requests.

The management of Federal programs to support health-related research or to facilitate its application to health services must take careful account of their impact on the participating institutions. These institutions usually have important functions and responsibilities that lie outside the fields with which the Federal programs are concerned. It is essential that they retain full responsibility for the management of their own affairs--that they have control over their education, research, and service activities; are free to implement their own plans for institutional development; and have first call on the professional loyalty of their faculty and staff. Special care must be taken to ensure that the expansion of facilities and growth of institutional activities stimulated by the Federal Government will take a form which will strengthen, rather than weaken, the total program, the organizational integrity, and the unique character of each institution.

Some of the NIH programs--such as the institutional grants--are specifically designed to strengthen participating institutions while many others--including the various kinds of center grants--are implemented in a way that will have this effect.

We also hope to develop administrative procedures which will give grantee institutions a more realistic role in the management of grant-supported projects. A pilot study is now underway in which responsibility for changes in project budgets or uses of grant funds, which normally require prior approval by the Public Health Service, has been delegated--with suitable guidelines--to the executive echelon of seven of the largest grantee institutions [the Massachusetts General Hospital, Massachusetts Institute of Technology, Columbia University College of Physicians and Surgeons, Rockefeller Institute, University of Pennsylvania, Johns Hopkins University School of Medicine, and the University of Michigan]. The items covered by this arrangement are expenditures for office equipment, laboratory equipment costing more than $1,000, travel, hospitalization of patients, publication of books and monographs, tuition charges, and alterations or renovation up to a limit of $2,500. One of the purposes of the pilot study--which will be evaluated at the end of a year--is to develop procedures for assisting other institutions to improve their grants management. We believe that placing administrative authority for decisions of this kind in the hands of responsible administrators who are closest to the research activity, will not only improve the administration of grant funds but will better serve the scientific aims of the grant projects.

In giving increased attention to the institutional aspects of our support programs we are not, of course, losing sight of the importance of the individual grantees. Research is done by investigators--not by institutions or their administrators. The traditional NIH project grants must continue to be a major element in our program.

Any comprehensive assessment of the projects support by NIH grants will show--as several recent reviews have, in fact, shown--that the quality of the research done has remained impressively high. There has, very properly, been concern--in the Congress, in the scientific community, in the Executive Branch and, indeed, at NIH itself--that the rapid expansion of the Federal support programs might lead to lower standards for the work considered eligible for support. There is ample evidence that this has not been the case. Actually, the overall quality of research has not merely been maintained but has risen significantly as a direct result of the expansion of the project grant programs.

I am happy to report that the quality of the work done by our grantees is fully matched by our intramural staff.

The maintenance of the stature of NIH as one of the outstanding research institutions in this country--and, indeed, in the world--is, of course, of great importance to the national medical research effort. The highly-qualified and dedicated scientists and technical staff who work in the Clinical Center and the NIH laboratories

in Bethesda, in Montana, in Panama, in Ghana, in Pakistan and, on special assignment, in other laboratories around the world are making significant contributions to the progress of biomedical science and its success in the constant battle against the onset and effects of disease. That these contributions are widely recognized and respected is shown by the awards and honors which NIH scientists continue to receive. For example, Dr. Marshall Nirenberg, who has already been widely honored for his major contribution to the understanding of the mechanics of genetics, was one of eleven scientists to whom the President awarded the National Medal of Science. The Bolivian Government has named a hospital and erected a bronze statue in memory of the late Dr. Henry K. Beye who, as director of the Middle American Research Unit, led the fight against Bolivian hemorrhagic fever. Dr. Willy Burgdorfer, of the Rocky Mountain Laboratory, received a John Simon Guggenheim Memorial fellowship for his distinguished work on viral and rickettsial infections.

A listing of the awards received by members of the NIH scientific staff for the outstanding job they are doing will be submitted for the record.

The quality of the intramural research at NIH is equally important to the maintenance of the quality of the extramural programs. This works in two ways. The presence on the Bethesda

campus of a cross-section of clinical investigators and bench scientists who are working in the forward areas of the research frontier makes it possible for those responsible for the direction of the extramural programs to keep abreast of new research developments, to spot new research opportunities, and to anticipate future research trends. In a field which is developing as rapidly as biomedical research and which involves so many scientific disciplines and specialties, this relationship is essential to sensitive and responsive policy development and program management. The fact that this relationship exists at NIH and the acknowledged standing of NIH as a first-class research institution also serves,in a subtle but very real way, to make the biomedical research community more responsive to NIH leadership in developing national programs.

I am, however, very much worried, about our ability to maintain high standards of scientific and administrative competence by the difficulties we have encountered in recruiting senior staff. The sort of persons we should like to have to develop new concepts and new approaches in an extremely broad and complex research area, can command much higher salaries--and with more attractive fringe benefits--in an academic institution than we are able to offer. The salary handicap is, for example, seriously affecting our ability to staff the new Division of Computer Research and Technology.

The effectiveness and viability of the NIH role in biomedical research--and, therefore, to a very large extent, the effectiveness of the whole national health research effort--will be significantly influenced by the quality of the professional staff in both the intramural and extramural programs. It is therefore essential that we should be able to recruit staff who not only have outstanding scientific and administrative competence but the vision to see the opportunities that lie ahead, the imagination to design fresh approaches to exploit those opportunities and the qualities of leadership necessary to insure that those approached are vigorously pursued.

The budget estimates for the Institutes and operating Divisions of NIH total $1,040,056,000. This amount represents an increase of $74 million, or about 7 percent, over the expected operating levels for the current year.

This budget, together with the funds that have been separately requested for Health Research Facilities Construction, direct construction, and the international activities using P.L. 480 funds, provides for a third year of restrained and selective growth following seven years of extraordinarily rapid expansion of the programs. The increases requested are focused on specific targets in areas of science in which progressive expansion seems most desirable--such as gerontology, child health, and toxicology.

An increase of $25 million--or about 6 percent--is requested for regular research project grants. Of this amount, approximately $19 million will enable us to meet commitments for the support of existing research projects (that is, noncompeting continuations). The other $6 million is requested to bring indirect cost payments by NIH into line with the current practice of other Federal grant-making agencies.

Increases totaling $18 million--or a little over 15 percent--are requested to strengthen the special research programs. Clinical research and special resource centers are playing an increasingly important part in extending this country's research capabilities to meet the challenges and exploit the opportunities that lie before us. The budget contains $57 million for these programs--an increase of $9.5 million, or nearly 17 percent, over their present level. The budget also includes an additional $6 million for the further expansion of the special grant program of the National Institute of Mental Health for hospital improvement. This program was started in fiscal year 1964 with an allocation of $6 million; the current allocation is $12 million; it is requested that $18 million be provided for fiscal 1966 for this important step in increasing the effectiveness of the treatment of mental illness.

Two new programs focused on areas in which there is both a great public need and a great scientific opportunity are included in the budget now before you. One is a request by the National Cancer Institute for $1.5 million to set up child leukemia centers. No cure for this tragic disease has yet been found but the curtains of mystery hiding its cause seem to be parting. The proposed centers will materially assist in accelerating leukemia research. The second new budget item is the proposal of the National Institute of General Medical Sciences to launch a program aimed at creating new resources for research and associated training in the fields of toxicology and pharmacology. These two fields represent a deficiency in the NIH research programs--especially in the light of mounting evidence that prolonged exposure to many chemicals and drugs now common in our environment may have long-term effects on health and, possibly, on heredity. The budget includes $1 million for this program.

The budget includes an increase of a little over $19 million--or about 8-1/2 percent--for the fellowship and training grant programs. Over half of this increase is in the training grant programs of the National Institute of Mental Health. The major increases among the other Institutes are: a little over $3.6 million for the National Institute of General Medical Sciences (of which $1 million is for predoctoral fellowships); exactly $2 million for the National Institute

of Child Health and Human Development; and about $1.5 million each for the National Institute of Arthritis and Metabolic Diseases and the National Institute of Allergy and Infectious Diseases.

Considered by activity, two-thirds (or more than $13 million) of the requested increases for fellowships and training are to permit the funding of 165 additional graduate training grants bringing the total of these vitally important training projects to 3,373. A substantial increase--about $4 million or nearly 23 percent over the current appropriation--is also sought for Research Career Development awards. This program, launched in fiscal year 1962, has amply demonstrated its effectiveness. The increase requested will permit 166 additional awards bringing the total number of current awards to 1,119.

The increases requested in the budget now before you are modest but they will enable us to maintain the momentum of the present programs. It is, however, a tight budget with no slack in any of its components. It is, therefore, important that we have some flexibility in administering the NIH appropriations. Unforeseen developments are a normal feature of effective research. In fact, if there were no unforeseen developments in the program of a research institution, I would begin to suspect that the institution was stagnating or doing very routine work. A vigorous research organization playing a major national role in a period of rapid scientific

developments cannot function as effectively as it should if it is bound too tightly to the details of budget estimates prepared twelve to eighteen months in advance.

The degree of flexibility necessary can be achieved by the provision, in the Bill now before you, authorizing the transfers up to 5 percent between NIH appropriations and by the removal of present limitations on reallocations within each of these appropriations. I should like to urge the Committee to give its most sympathetic consideration to these two requests.

During the past year there have been a number of changes among the directors of the Institutes and Divisions who will testify on the details of the various budget estimates.

Dr. Robert H. Felix has been succeeded as Director of the National Institute of Mental Health by Dr. Stanley F. Yolles. Dr. Yolles joined the staff of the Institute in 1954. He became Associate Director for Extramural Programs in 1960 and for the past year and a half has been its Deputy Director.

Dr. Clinton C. Powell, the first Director of the new National Institute of General Medical Sciences, has been succeeded by Dr. Frederick L. Stone who has been associated with the NIH extramural programs since 1958 including four years as Assistant Chief of the former Division of General Medical Sciences. He became Chief of the Division of Research Facilities and Resources when that was created in 1962. For the time being, Dr. Stone will continue to act in the latter capacity also.

Dr. Justin M. Andrews, the director of the National Institute of Allergy and Infectious Diseases, has retired. The new director is Dr. Dorland J. Davis who has been the Institute's Associate Director for Intramural Research since 1956.

Dr. Robert A. Aldrich, the Director of the National Institute for Child Health and Human Development, has resigned, for personal reasons, in order to return to the University of Washington School of Medicine. His successor is Dr. Donald Harting who has been Assistant Director of the Institute since its inception.

Dr. Charles V. Kidd has been succeeded as Chief of the Office of International Research by Dr. Charles L. Williams, Jr., who has been Associate Director for International Relations in the Office of International Health in the Office of the Surgeon General.

This concludes my prepared statement.

TAB 48

EDUCATION'S RESEARCH BASE*

The term "profession"--whether we speak of medicine, dentistry, law, architecture, engineering or whatever--connotes a calling with a deep obligation to know. It is many other things, of course--a dedicated practice, a social service, an ethic. But above all, it is a capacity to apply effectively a highly specialized body of knowledge and skill. And since knowledge is never static, a profession is also the obligation to advance and grow.

While the following remarks concern mainly science and medicine in the broadest sense, they will be relevant to many other fields. They will serve to emphasize the importance of a strong research base in education, not only with a view to advancing knowledge but also to providing opportunities for the continuing education of the professional.

Research Base of Education as Wellspring of Knowledge

More particularly, this presentation will discuss the nature and results of a vigorous research enterprise in the medical, dental and related sciences. It is widely felt that this enterprise has produced imbalances among the basic functions of

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* Presented by Dr. Seymour J. Kreshover, Associate Director of the National Institute of Dental Research, for Dr. James A. Shannon, Director, National Institutes of Health, at the Michigan Association of the Professions, Grand Rapids, Michigan, March 26, 1965.

the university--that is, education, research, and service. And yet a strong research component is widely agreed to be essential to full accomplishment of the university's mission. Hence, institutional imbalances should be redressed by positive moves in education and service rather than by weakening the research base.

We may ask, What is the deeper significance of research within the educational structure? Although much knowledge derives from practical experience and from nonacademic investigation, the university remains the wellspring of new knowledge in most professions. It could not meet fully its responsibility in teaching except as a participant in the research process. Research can be separate from education but not truly independent. Certainly, those who will enter a profession upon graduating from a university should be intimately familiar with the processes through which their knowledge was derived and capable of a sound experimental approach to new problems arising in practice.

Turnover Rate of Knowledge

The modern physician, dentist or other professional, whatever his badge, must maintain an open mind to new developments and actively seek the emerging facts. This becomes obvious when one considers that today's graduate will be practicing into the next century, and that major advances will be made over that time. If

this applies particularly to medicine and the allied professions, it is also true in engineering and architecture, business and public administration, the liberal arts, education and law.

The concept of "half-life," as used in nuclear physics, has been applied to the turnover rate of knowledge. It is said that the average engineer's knowledge has a half-life of $7\frac{1}{2}$ years. In other words, $7\frac{1}{2}$ years after graduation from an engineering school, he will be able to apply only half of what he learned there, and $7\frac{1}{2}$ years later, only half of the remainder. For civil engineering the half-life would be somewhat longer; for electronics, considerably shorter. Think of the progress from tubes to solid-state physics over the past decade. This concept emphasizes the importance of research and continuous education in the professions.

Federal Involvement in Academic Science

Since World War II the Federal Government has become increasingly involved in the support of basic science in schools of higher learning. The National Institutes of Health has played a major part in the expansion of biomedical science in medical and dental schools and in the graduate schools of universities.

In 1952 NIH contributed less than 10 percent of the $150 million spent that year by the Federal Government on research in schools. By 1963--when the total Federal expenditure for research in colleges and universities was approaching $1 billion--the NIH

share had grown to one third, representing a 23-fold increase in dollars awarded.* The Department of Defense, awarding 30 percent, remains the next largest Federal spender in the schools, but has diminished in proportion to other contributors. The greatest growth has been in programs of the National Science Foundation and the Space agency, now representing 12 and 8 percent respectively of Federal support to academic research.

Educational institutions receive nearly half of each Federal dollar spent on medical science, but only 12 cents of the Federal dollar spent for all R & D. Thus Federal agencies concerned with medical and health-related research are far more involved with the schools in the accomplishment of their missions than are other Federal agencies with science interests.

NIH Involvement in University Science Programs

We may draw from NIH experience in describing the support of basic science in the schools, for it illustrates the extension of Federal investment in university research programs. Prior to World War II, NIH was engaged primarily in a modest intramural research operation on problems of infectious disease. In 1938 cancer research was expanded with the creation of the National Cancer Institute. But it was not until the war years

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* Data here exclude university-managed Federal contract research centers, such as Los Alamos, Argonne, and Jet-Propulsion Laboratory.

had brought general awareness of the tremendous potentialities of science, as well as the serious rise in chronic diseases, that Congress established other Institutes at NIH to conduct and support research on mental disorders, heart disease, arthritis and metabolic disorders, oral diseases, neurological diseases, and other major health problems. Meanwhile, support rapidly exceeded conduct of research as NIH expanded its program of grants to universities, medical and dental schools, and other nonfederal institutions.

These developments resulted not only from mounting appropriations, but also from extension of the legislative base--from successive Acts of Congress imposing new responsibilities. It was early recognized that the principal program in support of the Nation's biomedical research must provide resources for the future--laboratories and clinics, trained manpower, and special resources such as animal-production and computer centers. The Division of Research Facilities and Resources at NIH was recently created to consolidate these growing activities.

Another responsibility of the expanding NIH program was recognized to be the support of basic and general science in our colleges and universities. Consolidation of activities to that purpose resulted in the establishment of the National Institute of General Medical Sciences, dedicated to the support of biomedical research not applied to specific disease categories. For the

Of prime importance has been the effect of NIH support on advancement of the biomedical sciences and the attack on disease. This acceleration of scientific progress is reflected in the further reduction of infectious diseases and in highly rewarding inroads into chronic disease problems. It is difficult to summarize the NIH contribution when 40 percent of the Nation's medical research support comes from its programs, not to mention construction grants and multiple training opportunities. But it seems reasonable to claim for NIH a substantial participation in the dramatic progress that has been made against certain forms of heart disease, cancer, mental illness, and other major health problems.

Within the schools and their affiliated hospitals, basic and clinical science programs have been strengthened. The environment for training physicians, dentists and biomedical investigators has been enriched, directly through training grants and fellowships and indirectly through support of research projects. NIH research grants to educational institutions have increased 15-fold since 1955--from $27 million to $400 million. There has been an ever-widening participation, with nearly 400 institutions now receiving some aid. These trends have resulted in a broadening of the base of excellence. In 1948 the top 25 universities received 50 percent of NIH funds; in 1963, only 42 percent. Moreover, all parts of the universities have been

affected--graduate, professional, agricultural, veterinary, and even undergraduate colleges of arts and sciences.

Another major effect is beginning to be felt. This is an impact on the character and quality of medical and dental service, brought about through new knowledge and public demand. As knowledge is developed and tested in centers of excellence across the land--as investigators and specialists apply their knowledge and skills to increasing numbers of patients--the health professions at large and the general public want to see the benefits of research made available to all the people. Thus a pressure is building to extend the quality and standards of clinical investigation into the teaching hospitals, the community clinics and health services, and the hands of the general practitioner.

Toward Strengthening the Educational Function

The broader effects of a vigorous research enterprise include, then, a tendency for research to dominate within the schools and a general demand for better medical and dental care. Are we to redress imbalances by retracting the research base? On the contrary, what is clearly required is a positive move in education and service. The elements of progress that would meet these needs are twofold.

First, greater effort should be made to provide sound undergraduate experience based on science. The schools should

be able to provide research training in depth, or at least exposure in depth, with a view to orienting the student to the dynamic nature of education and of future practice in an age of rapid advancement. Better mechanisms must be found for helping schools to augment and sustain educational programs grounded in scientific investigation.

The second necessary element would be adequate provision for continuous education of the professional. For the medical practitioner, such a program might be based in community hospitals connected with a university center.

This is consistent with the bill introduced in the U.S. Senate last month to provide for an extensive Federal program against heart disease, cancer, stroke, and other major illnesses. Grants would be awarded for the establishment of regional medical complexes--coordinated arrangements for research, training, and demonstrations of patient care in medical schools, research institutions, and hospitals. The objective of this legislation is to help the medical profession make available to patients the latest advances in the diagnosis and treatment of major disorders.

The bill would authorize an appropriation of $50 million for the first year and necessary amounts for the next four years. It does not provide for financing patient care except as incidental to research, training, or demonstration activities.

An alert medical profession will see in this type of program a means for providing continuous educational opportunities.

In dentistry, it is of some historical interest to note a milestone of development, as long ago as 1939, when the Kellogg Foundation provided substantial dollar support for the construction and operation of an Institute of Graduate and Postgraduate Dentistry at the University of Michigan--a center which, through the years, has served the continuing education needs of dentists the world over. But much more must be done and, we may hope, will be done.

Extrapolation of Current Trends

We can confidently predict that many new opportunities will be made available. With a broad research base and adequate support of educational and service functions, the Nation's schools will continue to play an active part in the development of new knowledge. This will have several important consequences. One will be a freer exchange of personnel between schools and independent laboratories. Another will be an increase in centers of excellence, setting new standards for educational programs. And third, a spirit of scholarship will prevail in the schools as they remain on the frontier of knowledge.

The university center, with effective lines of communication to the community, will then be in a position to offer continuing education for professional workers. Evolving programs will be an accommodation to trends already felt strongly in medical and dental practice. One outstanding trend is the acceleration of the rate at which new knowledge becomes available. This has led to changes in clinical practice, such as the shift toward specialization, with resulting modifications in the patient-doctor relationship. Programs for continuing education will be responsive to predictable progress in epidemiology, biochemistry, physical biology, virology, and the behavioral sciences.

In should be clearly understood that such programs must embody new teaching-learning situations. The need is not for mere information or technical devices to convey it. Effective opportunities for keeping up with new knowledge must be created. These will not arise from the schools alone, nor from the sources of support, but must reflect an active interest on the part of the professions themselves.

A vigorous program of continuous education for physicians and dentists will have many important consequences. It will help close the gap between research and practice; it will assure the practitioner up-to-date knowledge and techniques; it will result in better feedback of information to the research community; and it will bring institutions and industry into the

advancement of the health professions in constructive new ways.

Continuing Education Needed in Many Professions

Each of you will know the extent to which these remarks apply in your profession. Certainly neither medicine nor dentistry is unique in rapid change resulting from new knowledge, concepts, skills, tools and materials. The accumulation of knowledge from research produces accelerated change, and the professional now requires formalized programs for keeping abreast. One final point to be emphasized is that professionals in practice must work with schools to develop a sound research base. This base, in turn, can serve in continuing education to ensure the lasting vigor of the professions.

TAB 49

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"Creative Administrater" In The Evolution of NIH

By JAMES A. SHANNON, M.D.
Director
National Institutes of Health

IN THE QUARTER of a century that has passed since the beginning of what we may call the Second Scientific Revolution—the discovery of the nuclear fission reaction—the control of burgeoning science has become as complex, demanding and fascinating a task as any we face today.

Central to the problem of somehow fashioning a governor for today's scientific explosion is the necessity for managing science, if only, as one anonymous commentator puts it, "by arranging an environment and time so that the creative scientist is left alone to create." My everyday experience at the National Institutes of Health underscores the dictum of Royden Sanders, Jr., the managerial expert, who says, "The effective management of scientists and engineers presents, in many respects, a greater challenge than the development of sciences and technologies themselves. Historically, no clearcut and consistently proven pattern of scientific management has yet developed. There is management of scientists, but as yet no science of management—especially of the management of scientists."

The national commitment to expand scientific training and research has continued to increase in proportion to the nation's increasing dependence on science. While it would be interesting to trace the development of this commitment, I believe it is sufficient for our present purpose to note that, at long last, there appears to be less trepidation at the thought of, and a much wider acceptance of the necessity for, long-term programming, a *sine qua non* if we are to continue to provide a solid administrative base for the support of science and scientific creativity in all of its ramifications.

The Creative Process

I shy away from any *definition* of the creative process, but I am in general

DR. JOSEPH J. KINYOUN, who in 1887 initiated medical laboratory research within the PHS. The photo above was reproduced from a painting at NIH.

accord with those who hold that it consists essentially of the formation of hypotheses, their testing and the presentation of the results in understandable form acceptable to a group of the creator's peers. The end result is in a contribution of new knowledge to the scientific world. Hopefully, the new knowledge may be revolutionary; more often, it is of the evolutionary type that characterizes orderly scientific advance.

While various spokesmen differ as the *elements* that enter into the creati process, there is little argument with t postulates of Helmholtz, who describ them as Preparation, Incubation, a Illumination. To this we may add fourth step, Verification or Developme as Graham Wallas and others have do These elements can be found in a creative work, although not necessar in the order given here. Further delin tion or subdivision becomes a matter choice, just as the use of other nom clature is a matter of individual ju ment.

Today's literature, popular as well scientific, contains a great deal of w ing about creativity in the laborato which is usually stated in terms of, equated with, productivity. On the ot hand, we do not read or hear so m about creative administration, altho it is obvious that it parallels crea science and may be antecedent to i

Creativity in Administration

Administration defies easy conc definition, but may be considered as cluding all efforts that need to mounted to initiate, order, and g whatever processes must be devise pursue prestated or desirable objecti

The scientific administrator's job, t consists of more than merely estab ing an environment that will be chologically and physiologically nable to a wide range of multidis nary activities. In addition to this ac modation, there must be a "climat which the scientist-investigator is from major administrative requirem unhampered by periodic measuren of progress and reports, and not ch with conforming to rigid criteri method or performance. The indiv investigator remains the backbone c research system and any attempt to condition his creativity is to indul a senseless type of aborticide.

"Creative Administrator" In The Evolution of NIH

Now when one thinks of the administrator and relates him to the management of science, one should have two essential types of persons in mind. First and foremost is the program leader who almost certainly will and should emerge from the ranks of science as a scientist who is interested in and able to direct scientific endeavors and to motivate scientists to follow and accept that direction.

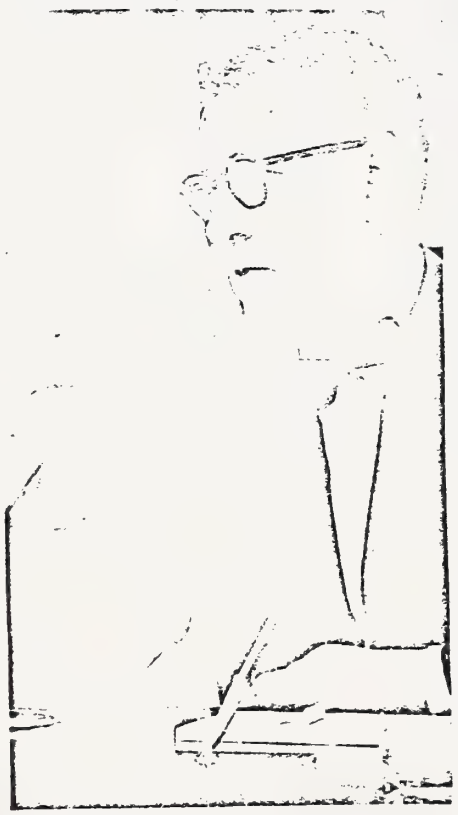
Secondly, one refers also to the non-scientist whose speciality is the art of administration and who comes to his task most typically educated in the liberal arts and trained in one or more of the social sciences, e.g., budget, personnel, statistics, economics, and the like. This person too is an indispensable component of the management of science who operates in a support role to the program leader to, among other tasks, formulate budgets, hire, place and train people, structure organizations, formulate, explain and codify procedures.

Both persons are essential to the management of science and although this presentation is oriented toward the program leader, I would not want the contribution of the non-scientist to be overlooked.

The scientific administrator, then, scientist or not, must reconnoiter the future, fend off and answer the loyal opposition, overcome indwelling inertia, estimate and justify budget and manpower needs. He must, moreover, manage these and a host of associated functions while creating methods, operating procedures, an organization and relations within that organization that will allow the imposed "variables" to approach as nearly as possible the "constant" of scientific creativity and accomplishment.

And yet, since no two organizations have an identical purview, there is always room for enterprise, innovation, and personal resourcefulness. If the administrator brings to his task imagination, faith in his mission, an emerging vision of what the future can hold, and confidence in his own ability to steer the organization to its objectives, he has a personal involvement in, and is dealing with, the heart of creative administration.

The problems of the creative administration of a Federal research program are shared in a large measure by the various Federal agencies charged with the administration of research, whether it be the National Aeronautics and Space Agency or the Department of Health, Education, and Welfare. Further, if we narrow to the fields of public health and research, our experiences as an agency of the Public Health Service in the Department of Health, Education and Welfare may be of some interest—and perhaps of some value for their suggestiveness—to administrators elsewhere in the Federal research complex.



DOCTOR JAMES A. SHANNON
seeks the creative administrator

Creative Administration in Public Health Service Research Programs

Creative administration goes beyond challenge and response. I can think of no man who better illustrates this than Dr. Joseph J. Kinyoun who initiated medical laboratory research in the Public Health Service in 1887. At that time the epidemic diseases — cholera, smallpox yellow fever—were frightening national hazards, and as a bacteriologist Dr. Kinyoun was fired with a determination to meet this challenge to public health. He was a good bench scientist—he first isolated the cholera organism in immigrants—but he was more than that: he was an able administrator who was capable of making substantive policy recommendations for the Service, some of which were later carried out by his successors. A man of practical turn of mind, he had the vision to simultaneously understand the new diphtheria anti-toxin of the Pasteur Institute and to foresee the need for regulations to guarantee the safety and effectiveness of this new product when it should in time be mass-produced.

This element of anticipation of need to come is one of the vital elements of creative administration. We see this element again at work in the 1930s, when the dramatic decline of infectious disease began to be offset by an increase in the toll being exacted from our population by the chronic and degenerative diseases. Just as Kinyoun had anticipated some half a dozen years the need for biologics standards, so Surgeon General H. S. Cummings, in his annual report for 1931, recommended the expansion of cancer research within the Service.

Within a few years cancer research in the Public Health Service began to expand, culminating in the establishment of the National Cancer Institute by the Congress in 1937. With the setting up of this first major entity at NIH to serve a specific health problem the disease oriented structure was initiated which characterized NIH organization until very recently when institutes centered on the general medical sciences and on phenomena of human development were established.

The Research Grants Program of the Public Health Service

The need for anticipation of needs to come was never greater in the long history of the Public Health Service than when the Service began its research grants program in the 1940s. At that time the Service was fortunate in having Dr. Thomas Parran as Surgeon General, for he not only had a keen awareness of the past medical research potential of the nation but also the vision to anticipate greatly increased participation of Federal government in its support.

Dr. Parran was empowered by the Public Health Service Act of 1944 to use a grants-in-aid program with universities, laboratories, and other public or private institutions and to award grants to individuals whose projects were recommended by the National Advisory Councils (at that time, two.) With Dr. Rolla E. Dyer, Director of the National Institute of Health (the name "Institutes" was still in the future) Dr. Parran established a Research Grants Office at the beginning of 1946 to administer research contracts of the Office of Scientific Research and Development that re transferred to the Public Health rvice after World War II.

But it is not enough for an administrator to anticipate future needs. He must have the knack of attracting men to aid him in the professional direction of his programs. Drs. Parran and Dyer had this knack, and together these men and their assistants unified the administration of all Public Health Service extramural research grants and contracts. The administrative foresight of this group was such that the principles they laid down to operate a program of less than 100 grants provide the basis for operating a program of some 16,000 research grants today. The wisdom of the review mechanism they conceived is generally realized. The sponsoring institution reviews the grant application before forwarding it to NIH for further view by a study section and final appraisal by a National Advisory Council. This process does as much as can humanly be done to assure the quality and scientific merit of an individual grant application, and ultimately reflects the decision of a cross-section of the nation's scientific community.

There is little need here to note again the values of the project system as developed over the past 15 years. That it has operated effectively was demonstrated a few years ago when the 85th Congress passed legislation enabling other Governmental agencies to establish and operate grants programs modeled after the one pioneered by the Public Health Service.

Research Training Programs

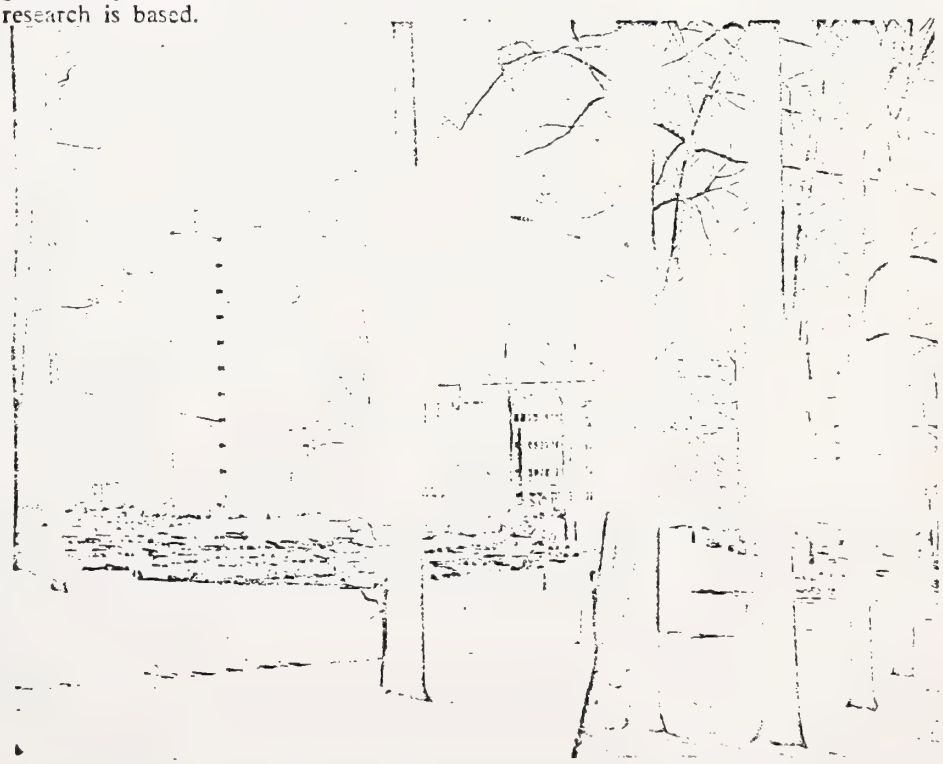
This same group of planners recognized that the research grants program they envisioned would inevitably falter and fail if no effort was made to sustain its manpower base. Armed with the experience gained by the National Cancer Institute (which had been awarding fellowships on a modest scale since 1938) and with the authorization contained in the Public Health Service Act of 1944 to award fellowships, traineeships and training grants, they set to work to conceive, develop and foster a variety of training programs. Initially these efforts were in the disease categories of the Institutes—cancer, heart, etc.—but by the late 1950s it had become apparent that more needed to be done and a new Division was established in the general medical sciences, one of whose missions was the support of training unrelated to any particular disease but designed to provide the fundamental understanding of the structure, organization, functions of living cells and organisms upon which all disease-oriented research is based.

NIH training and fellowship programs seek to provide scientists for tomorrow who in addition to carrying on research will attract and help train yet another generation of scientists. Over the years NIH has evolved various programs designed to help medical schools and other training institutions increase the numbers and quality of medical and biological investigators and to provide opportunities for intensive training of scientists both before and after they have earned the M.D. or Ph.D. degree.

The Administrative Test

In looking back over the past 20 years and in reviewing the various programs the Public Health Service has evolved to support health and health-related research and training, I do not want to give the impression that there was an inevitability that these programs would develop as they did. What may appear obvious and even inevitable in 1965 was not necessarily obvious and inevitable in 1945—and in connection with some of our programs, is still not so, today.

These progams must be conceived and launched and then proved and improved. To those of us intimately concerned with this experimental process, the various stages of it are very clear: the "preparation," often protracted and at times frustrating; "incubation," or the gestation of ideas; "illumination," when the results begin to take shape—sometimes as we expected, sometimes not.



WINTER VIEW of the NIH Clinical Center, which has a staff of over 1800 personnel. A total of over 11,000 persons are employed at NIH.

Enough time has now elapsed to permit us to trace this creative process in some of our programs through succeeding stages to the final one of "verification." As an example I might cite the continuing relationship of clinical medicine and research at NIH. This relationship is intimate because it is quite clear that if medical knowledge is to be advanced, the various health disciplines must be merged in clinical medicine, which concentrates on the whole man. This is, in fact, clinical medicine's greatest research mission. Hippocrates long ago focused full attention on the patient, and ages before Hippocrates was born, men had studied health and disease in individuals.

To a large extent medicine grew up by the process of men observing the sick and treating them, observation and discovery leading to new knowledge. Could this process be accelerated? It is, I think, a tribute to the extraordinary awareness of the lessons of history and of the potentials of their own times that the Public Health Service planners in the 1940s had the vision to answer this question affirmatively. They planned a special research facility designed to enable representatives of all the medical sciences to work together closely with clinicians, thus enriching each other's research and at the same time contributing to more effective treatment of the patient. Before the opening of the Clinical Center in 1953, a colleague had this to say of the new facility:

"Reduced to its simplest terms, medicine and the laboratory sciences have grown indispensable to each other; at the same time each has become so intensively specialized that effective communication between the two broad fields, and between the numerous specialities within each, has become inordinately difficult. Man cannot devise a more desirable and effective system of communication than the direct, face-to-face method. The Clinical Center will provide a means for bringing together in constant intellectual and physical contact outstanding practitioners in virtually all the clinical and laboratory specialities. This will be done in the presence of that most powerful inciter of creative thought—the sick human being for whom the vast potentialities of medical science have not yet been realized. The ultimate purpose is to help provide the practicing physicians of this nation—and of the world—with better means for ameliorating physical suffering and emotional imbalance, for prolonging human life, and for making human life, and for making all the years of that span more useful both to the individual and to society."[1]

In the intervening years, the successful operation of the Clinical Center at NIH led not only to the conclusion that the "verification" originally sought in this effort was being achieved but also that small, but discrete units modeled on the Clinical Center might serve the needs in other institutions throughout the nation.

This program has wide implications—especially pertinent to the Public Health Service mission of promoting better health for the American people—in that these skilled physicians, highly trained staff, physical facilities and laboratories will advance medicine by providing a bridge between clinical practice and those basic studies in science which offer new approaches to the prevention and treatment of disease. It is also quite possible that the currently proposed national network of medical complexes for diagnosis and treatment of the major killing and crippling diseases can be ordered in such a way as to benefit from the pioneering experiences of the Clinical Center and the clinical research centers now in operation.

In some instances the results of our programs have not been precisely as expected. My second example has to do with a program to increase the number of stable, full-time career opportunities for scientists of superior potential and capability in sciences related to health. Two categories of awards were provided: "career" awards, designed to support established investigators for the duration of their careers, and "development" awards, designed to finance research positions for younger but promising scientists for up to 10 years.

By 1964, 236 researchers held career grants at a cost of $5.5 million annually and 805 others held development grants at a cost of $14.5 million annually. The sheer growth of the program and the necessity for the NIH to involve itself in each award virtually as an employer began to over-shadow the primary objective of providing stable support for high caliber scientists. In policy terms, then, we confronted a challen

NIH RESEARCHER at work in the Clinical Center.

in creative administration which led us to modify certain phases of a program very carefully developed less than five years earlier.

The original intent was unquestionably good. There is no doubt that the scarcest and most valuable resource at every education level is faculty. Now the most interesting aspect of the matter —from the administrative viewpoint— is whether our administrative creativity will permit us to profit from our experience, capitalize on the gains we have made, and move on to evolve programs that will truly serve today's needs and prepare us for tomorrow's opportunities.

My third and last example concerns research facilities and resources. It required no special "illumination" on the part of the Public Health Service architects of our grants program twenty years ago to perceive the need for improvement in the research environment, if all projected medical research efforts were not to fail because of a lack of adequate logistical support. Many institutions in this country had limited, poorly equipped laboratories, often situated in old and obsolete buildings with totally inadequate space. Remodeling and renovation and the construction of new buildings were clearly indicated and most urgently needed.

To meet these critical but often costly needs NIH over the years etsablished diverse programs within its Institutes and Divisions, but by the mid-1950s it was apparent that administrative ingenuity within established lines could not keep pace with expanded research efforts and that more must be done. The Congress was urged to authorize funds for the construction and equipping of new and remodeled facilities, and since 1956 we have had this authorization, with awards being made on a matching basis for up to 50 percent of the construction costs. To date such awards have contributed to the construction in all states of new and remodeled facilities costing well over $1,000,000,000.

By 1962 we had had considerable experience with this program and had reached a stage in our thinking about the general problem of enhancing the research environment that enabled us to launch a series of related programs. As a result of that "illumination" we began — for example — a General Research Support Program to encourage research and research training in the sciences basic to health but not necessarily committed to any particular research or training project, and these grants were to be used in the way the institutions receiving them considered most effective.

We have now gone further. For example, as a result of the increase in biomedical studies, the need for laboratory animals has increased, and so has the need for unusual species and special strains. NIH has therefore helped set up animal research centers to encourage research in the basic problems of diseases of research animals and the development of special genetic strains for special medical research purposes. We are supporting seven regional primate research centers where resident and visiting scientists representing many disciplines will study various biological characteristics of primates throughout their life span. I would emphasize the word regional, for these centers—as well as certain other resources NIH is now supporting—are for us in an area as large as a geographic region of the United States.

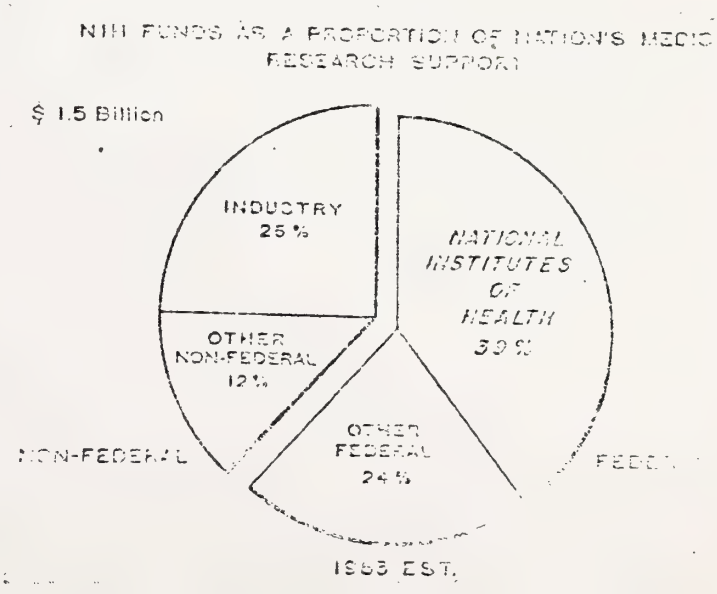
Within the last half-dozen years we have learned to think in terms of regional support in a number of our programs at NIH. The technological developments which brought large, expensive equipment such as computers into the biomedical research effort has led us to support these, too, on a regional basis because only maximum use can justify such costs. These computers will be used not only by scientists within the institutions housing the equipment but by those working in private hospitals, public health departments, voluntary health agencies, medical schools, or Veterans Administration hospitals.

Clearly, what is happening is that the NIH has evolved new and supplemental mechanisms. While not abandoning its grants-in-aid to individuals, it has gone on to offer institutions themselves grant support for projects greater than any one person's—or even one institution's —capabilities.

It is too early to speak of the "verification" of these programs in practice. Sometimes they include variables that are not expected, and sometimes they are capable of cancelling out other programs of NIH. The successful monitoring and modification of all of these varied programs is essential to good administration—and a constant challenge to creative administration, as I defined and delimited it earlier.

The Scientist as Administrator

With that brief array of examples I suppose I should rest my case. But there is an associated thought that I believe needs expression and much wider consideration. I refer to the present critical and growing need for a greater number of qualified scientific administrators in the nation's expanding scientific and technical programs.



TAB 50

[Reprinted from *Bulletin of the History of Medicine*, Vol. XXXIX, No. 3, May-June, 1965.]

THE FEDERAL GOVERNMENT AND HEALTH RESEARCH, 1900–1960

A SYMPOSIUM

Held at the 37th Annual Meeting of the American Association for the History of Medicine, May 1, 1964, at the Clinical Center, National Institutes of Health, Bethesda, Maryland

Introductory Remarks *

PHILIP SAPIR, *Chairman* **

I take pleasure in joining Dr. Shannon in welcoming the Association and its members and guests to the National Institutes of Health. I was pleased to have been invited to serve as Chairman of this Session and recall that it was in 1958 that Dr. Jeanne Brand and I had the pleasure of reporting to the 31st Annual Meeting of this Association the development at the NIH of a program of support for research and training in the history of medicine and life sciences. This is a program which now

* This is an edited version. Apart from other editorial changes, the names of the main speakers, who were introduced individually preceding each paper, have here been grouped together.

** Chief, Research Grants Branch, National Institute of Mental Health.

DISCUSSION

Opening Remarks by Dr. Shannon

I would like to address myself primarily to some of the comments made by Dr. Rosen and Dr. Dupree.

Dr. Rosen has pointed out that science and science policy in this country have developed in phases, one being preparatory to the other, and one moving into the other after experiencing a sense of instability. He has shown clearly the need for the historian to define the forces at work which create the basic instability, first as an exercise in itself, and then, secondly, as a guide to our actions in the future. I think that the situation we face today could be even more momentous than the critical periods which we have experienced in the past—in the twenties and early thirties, and the period just after World War II. As a result of a whole series of uncontrolled events and forces, at times working against one another, we have evolved a very broad system of science support in this country, which could conceivably have the seeds of destruction for institutions of higher learning contained within the very programs that, at the present time, are looked upon as being so forceful and so productive of new information.

Science is supported in this country today through a series of mission-oriented agencies, of agencies which have quite precise missions: the Atomic Energy Commission, Department of Defense, the Space Agency, Department of Health, Education and Welfare, and the National Science Foundation. Even in the case of the National Science Foundation, its special purpose is the support of science and of no other element of higher education. The second thing which is troublesome is that all of these agencies are supportive of a single university function, namely research. And, if one could define the man of today, he is not the individual who has achieved scholarly eminence through his objective appraisal of things happening over the years, through his maturity of judgment, and ability to appraise science within the changing social structure. The man on the campus today is the young, tough-minded, vigorous scientist, the productive man; and we have no means, basically, of either fostering or developing, or cherishing, scholarship or scholarly learning as an end in itself.

Now if, as most people believe, the future of this nation, or certainly the course of its development during the last half of this century, will be

determined largely by the effectiveness with which we exploit our intellectual resources, then certainly the present situation should give pause for concern. Our support mechanisms, in general, foster the early emergence and broad support of the individual scientist. But, I might say that the sprawl of agencies that are ready and willing to support the individual scientist are many and complex, and the manifold sources are looked upon as a protective device, a fortunate thing, because the multiplicity of sources to that extent minimizes the possibility of Federal dominance. But, I would say that, importantly, these same mechanisms, the same devices, the same multiplicity of special-mission agencies, tend to distort the university.

I believe none of us would say that we can effectively exploit the intellectual resources in this country without strong universities, stronger even than they are at the present time, where the university world is characterized by the development of further centers of excellence rather than by the simple continuation of those that exist today. If one looks at the university development as it has occurred in this country, one sees that it has followed a pattern set by some of our great private universities rather than one controlled and set by federal agencies. And yet, we are in a difficult position to find a way or means of helping the private institution and its manifold problems of development of tomorrow. I think that what we need, above all else, is a coherent set of principles, purposely developed, which relate the Federal Government to the totality of our institutions of higher learning, rather than to one of the special purposes of the university. I think that history will show in retrospect that the constituent agencies of the Federal Government have used the university world for their own purposes and, to some extent, by using only a part of the university, or supporting only a part of the university, have to that extent subverted the university in its normal evolution.

I think that these situations, as they occur today, should be of very deep concern to more thoughtful educators. The thing that is discouraging to some of us is that they do not appear to be of very deep concern. We find, in our association with the scientists across the nation, that there is some measure of distrust of their own administration. They will actively oppose the development of such programs as general research and training programs, or institutional grants, or the like, because this tends to swing the power-axis, if you will, in favor of the administrator. The young scientist of today has little regard for his own administrators, so that we stand a very serious chance of developing a series of what I have called very fancy "scientific boarding houses" rather than secure institutions to protect our intellectual activities.

I think that the time is very ripe, on the other hand, for very thoughtful analysis of our situation and for much more aggressive action on the part of those associations that should be looking out for the interests of our institutions of higher learning. This is particularly true now because a great deal of soul-searching is going on within the Congress and the Executive Branch. Looking forward to a total expenditure of $15 to 20 billion a year in support of research and development, the Congress is beginning to wonder how much, and how much further, the normal course of events will bring it. Since Sputnik first took off, the Executive Branch has systematically attempted to grasp some measure of control through a revitalization of the President's Science Advisory Committee, the appointment of the President's Science Advisor, the establishment of a Federal Council for Science and Technology, and, more recently, the establishment of an Office of Science and Technology. There is a great deal of soul-searching going on at that level.

But I don't see, in the developing dialogue, any strong measure of broadly based philosophical concern from within the university world. I am well aware of the recent writings of Dr. Pusey. I think that he and others have in mind an attempt, I suspect by analytical means, to find out a little bit more about what are the deficits in the relationships between the Federal Government and the university, rather than what are its benefits. I think we spent too much time, in the past five years, indicating what a fine relationship we have; and I think this is not entirely healthy. I feel that the relationship is good indeed and that it has been good. But, my remarks are aimed at the point that this is not a basis for future development and that we are, at the present time, at one of these critical periods of decision. Depending upon what decision is made, many great things can happen.

Discussion from the Platform

Dr. Stevenson: * I found the remarks of Dr. Shannon both reassuring and challenging, and I feel that this Association should be particularly concerned with the problem that he has outlined. I wondered, Mr. Chairman, if some other members of the panel, had, in the course of their researches, encountered in the past any evidence of concern. After all, this is a sort of "hot history" symposium and we need not take it too far back into the past, but I wondered if they had encountered any evidence of concern with the one-sideness of this kind of development. They have

* Dr. Lloyd Stevenson was the President of the American Association for the History of Medicine for 1962-1964.

TAB 51

Reprinted from THE AMERICAN REVIEW OF RESPIRATORY DISEASES
Vol. 92, No. 4, October 1965
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MEDICAL RESEARCH

JAMES A. SHANNON[1]

(Received for publication June 3, 1965)

It is gratifying to address an organization that has been so long in the forefront of medical service and research, and one that has proved so adaptable to revolutionary changes wrought by science. For such changes are in progress today with increasing momentum. They are felt in the institutions of higher learning, in the clinic, in the physician's office, and in the community at large. I have no doubt that the National Tuberculosis Association will play an active part in these changes with traditional spirit and competence.

One can say this with assurance, in reflecting on the history of the contributions of the National Tuberculosis Association to tuberculosis control in this country. These relate to a comprehension of social components of disease and to the effective use of health education, mass screening, and the health survey. The National Tuberculosis Association has played an equally important role in the dissemination of information to physicians, the development of rehabilitation, and the successful application of chemotherapy. Finally—though one speaks with considerably less enthusiasm—there has been the sad but important lesson learned from relaxing too soon.

[1] From the National Institutes of Health, U. S. Public Health Service, Bethesda, Maryland.

In the history of tuberculosis control, the leadership of the National Tuberculosis Association is clearly apparent. Recently, that superb leadership has been extended to the control of other respiratory diseases. The strategy and tactics of this effort will doubtless be determined, in part, by some of the forces and trends we will be discussing this evening.

THE POSTWAR DEVELOPMENT OF MEDICAL SCIENCE

It is clear that, since World War II, the world has entered a period in which science and technology have a position of unprecedented importance, and we observe that knowledge begets knowledge at an accelerating rate. Much, if not most, science and technology is applied to the control of our environment or our reactions to it. The effort to "subdue the earth"—to gain control over the physical and biologic events that condition and shape our lives—is as old as mankind, but modern science has proved the superlative instrument. Most important in man's relation to his environment is his state of health, and scientists from all fields are applying themselves to health-related phenomena in increasing numbers.

A quantitative measure of this trend is the change in the proportion of all research and

development that is devoted to medical research. Since the mid-century point, expenditures for medical research have risen in the United States from about 5.6 per cent to 8.8 per cent of all Research and Development. In absolute terms, the growth has been even more impressive: from about $160 million in 1950 to an estimated $1.85 billion in 1965. This represents an escalation of effort to improve the human condition, drawing on all sectors of the economy—government, industry, and philanthropy. And it will continue to affect higher education and medical service in major ways.

The Scientific Base of Medical Education

Medical education in the United States is undergoing a major transition. One obvious change is expansion, in the form of new schools, medical centers, laboratories, and enlarged student capacity. Between 1957 and 1963, the total operating expenses of medical schools more than doubled, rising from $240 million to an estimated $600 million.[2] The number of full-time faculty has more than tripled since 1951: 4,000 to 14,500. Over the same period, the student body has risen from about 26,000 to 32,000. The total student load for all schools last year was 70,000, counting interns and residents, graduate students and postdoctoral fellows in the sciences, and students in the other health professions.

Equally significant changes concern the framework and content of education. There has been an accumulation of knowledge in old disciplines through the entry of mathematics and the physical sciences; the behavioral sciences have come of age; and medical research tends to cross disciplinary lines rather than be restrained within them. These developments could lead to curriculum changes at the very least, and even to modification of the departmental structure of the medical schools.

Broadly speaking, the medical sciences have emerged in a central role in the educational environment. This represents a flowering of programs that date back in some schools to the turn of the century, when a scientific base for medical education was exceptional. Yet men of vision, like Abraham Flexner, stressed the essentiality of research in the educational process.

Flexner's report to the Carnegie Foundation in 1910—a study that revolutionized medical education in this country—described three stages in the evolution of medical teaching. The first and longest was the era of *dogma*. The teachings of Hippocrates and Galen, though derived largely from observation and experience, were transmitted for centuries as an authoritative canon. Flexner calls the second era *empiric*. It began with the introduction of anatomy in the sixteenth century and reached its zenith in the eighteenth. This was a period of heroic therapeutic measures, sometimes deduced from metaphysical assumptions, but increasingly derived from observation and experiment. Teaching during this period was based as much on persuasion as on rigorous proof. In the third era, medicine is conceived to be *grounded in modern science*.

Some distinguishing characteristics of scientific medicine, according to Flexner, are these: procedures, instruments, and drugs are constantly subjected to critical evaluation; speculation is minimized except as a basis for further study; and progress is made through research, i.e., accumulation of facts and their analysis. Furthermore, the progress of science and the intelligent practice of medicine employ the same technique: observation, hypothesis (or diagnosis), action, critical review of progress, and perhaps modification. Flexner states: "The student must be trained to the positive exercise of his faculties; and if so trained, the medical school begins rather than completes his medical education."

The Physician in an Era of Science

The accelerating emergence of knowledge not only implies that the physician must be scientifically oriented, but that a means must be purposely built into the educational system for his continuing self-development. Today's graduate, given an average life span, will be practicing medicine into the next century. In this era of science and technology, he will feel keenly his "obligation to know." Almost surely, he will seek formalized opportunities for continuing education beyond the short-term graduate course.

Without being too specific, one can confidently predict that the dynamic state of knowledge and its demands upon physicians will occasion other significant trends. Changes may be expected in premedical education, in the preparation for

[2] Includes teaching expenses of university hospitals.

clinical medicine, and perhaps in licensure procedures. The ground swell of science will be felt in all aspects of medical education and service.

The new dynamic state of medical science is leading to profound changes in medical care. The growing complexity of knowledge, techniques, equipment, and so forth, has been a prime mover in the trend toward specialization and group practice. In short, more specialized knowledge has led to more specialization in virtually every branch of medicine. A parallel development has been the expansion of services to physicians, ranging from business and clerical assistance to professional laboratory and clinical procedures. Other sweeping changes are seen in the economics of medical care as a result of expanding health insurance coverage, institutional medicine, and governmental insurance and support programs. Whatever our personal views on these trends, we must recognize that they are a product of complex interactions between socioeconomic factors and the "state of the art." As trends, they will continue, and will lead us far from the older type of personalized medical care.

The Regional Medical Complex

The over-all picture is one of transition in the ways that medical services are deployed. In some areas of medicine, mission-oriented programs, as well as specialized knowledge and facilities, may combine to produce specialized institutions deployed on a regional rather than on a community level. Such major health problems as cancer, heart disease, and stroke are amenable to an approach in which these concepts are combined, less as separable entities than as part of a complicated research, educational, service complex.

Such a regional medical center—say, a university hospital or other source of knowledge, skill, and equipment—must be characterized by broad scientific excellence, extensive teaching capability, and adequate means for specialized study, diagnosis, and treatment of an array of important diseases. Such a center cannot be sustained on a community basis. But medical care of the quality found in our best centers can reach the population at large through related local facilities.

The concept of a regional network is emerging for several reasons. One, it is a natural outgrowth of specialization and the growing complexity of diagnostic and therapeutic procedures in many fields. More important, it removes a major limitation on the continued outflow of information useful to the physician in the community as he approaches his daily, increasingly complex, professional problems.

The evolution of the regional medical complex cannot proceed apace without the cooperation and active support of the medical profession, the public, and the agencies that see it as a means of furthering their missions. Voluntary health agencies, Federal research programs, and state and local health departments could lend valuable help. A network of case-finding and treatment centers, community-based and strongly linked to sources of medical knowledge, could characterize a new era in disease control.

Setting the Standard of Medical Service

The college-affiliated hospital or medical center, academically staffed and research-oriented, is setting the standard for medical care in this country. It is the environment from which today's medical graduate emerges, the environment he will demand for his patients and his own self-development. And the community center with equivalent standards, multiplied many times around the hub of a great medical school complex, is a natural extension. Already one feels a strong and growing community demand for medical service of the caliber found in the Nation's centers of excellence.

Schools, professional associations, supportive agencies, and community services have their parts to play in extending the research base of medical education and in bringing scientific medicine to the greatest possible number of people. The physician, with the aid of these groups, will seek better means to further his self-development, adapting and contributing to the dynamic state of knowledge. And the voluntary health agency will remain an integral part of the medical community, continuing to serve importantly in the conquest of disease.

The Emerging Role of Science In Medical Education and Service*

JAMES A. SHANNON, M.D.**

Washington, D. C.

It is gratifying to address an organization that has been so long in the forefront of medical service and research, and one that has proved so adaptable to revolutionary changes wrought by science. For such changes are in progress today with increasing momentum. They are felt in the institutions of higher learning, in the clinic and physician's office, in the community at large. I have no doubt that the National Tuberculosis Association will play an active part in these changes with traditional spirit and competence.

One can say this with assurance in reflecting on the history of NTA's contributions to tuberculosis control in this country. These relate to a comprehension of social components of disease and to the effective use of health education, mass screening, and the health survey. Equally, this organization has played an important role in the dissemination of information to physicians, the development of rehabilitation, and the successful application of chemotherapy.

The Postwar Development Of Medical Science

It is clear that since World War II the world has entered a period in which science and technology have a position of unprecedented importance, and we observe that knowledge begets knowledge at an accelerating rate. Much if not most science and technology is applied to the control of our environment or our reactions to it. The effort to "subdue the earth"—to gain control over the physical and biological events that condition and shape our lives—is as old as mankind, but modern science has proved the superlative instrument. Most important in man's relation to his environment is his state of health, and scientists from all fields are applying themselves to health-related phenomena in increasing numbers.

A quantitative measure of this trend is the change in the proportion of all research and development that is devoted to medical research. Since the midcentury point, expenditures for medical research have risen in the United States from about 5.6 percent to 8.8 percent of all R & D. In absolute terms, the growth has been even more impressive—from about $160 million in 1950 to an estimated $1.85 billion in 1965. This represents an escalation of effort to improve the human condition, drawing on all sectors of the economy—government, industry, philanthropy. And it will continue to affect higher education and medical service in major ways.

The Scientific Base Of Medical Education

Medical education in the United States is undergoing a major transition. One obvious change is expansion, in the form of new schools, medical centers, laboratories, and enlarged student capacity. Between 1957 and 1963, the total operating expenses of medical schools more than doubled, rising from $240 million to an estimated $600 million.† The number of full-time faculty has more than tripled since 1951—4,000 to 14,500. Over the same period, the student body has risen from about 26,000 to 32,000. The total student load for all schools last year was 70,000, counting interns and residents, graduate students and postdoctoral

*Presented at the annual meeting of the National Tuberculosis Association, Chicago, Illinois.

**Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

†Includes teaching expenses of university hospitals.

*Delivered May 30, 1965

fellows in the sciences, and students in the other health professions.

Equally significant changes concern the framework and content of education. There has been an accumulation of knowledge in old disciplines through the entry of mathematics and the physical sciences; the behavioral sciences have come of age; and medical research tends to cross disciplinary lines rather than be restrained within them. These developments could lead to curriculum changes at the very least and even to modification of the departmental structure of the medical schools.

Broadly speaking the medical sciences have emerged in a central role in the educational environment. This represents a flowering of programs that date back in some schools to the turn of the century, when a scientific base for medical education was exceptional. Yet men of vision, like Abraham Flexner, stressed the essentiality of research in the educational process.

Flexner's report to the Carnegie Foundation in 1910—a study that revolutionized medical education in this country — described three stages in the evolution of medical teaching. The first and longest was the era of *dogma*. The teachings of Hippocrates and Galen, though derived largely from observation and experience, were transmitted for centuries as an authoritative canon. Flexner calls the second era *empiric*. It began with the introduction of anatomy in the 16th century and reached its zenith in the 18th. This was a period of heroic therapeutic measures sometimes deduced from metaphysical assumptions but increasingly from observation and experiment. Teaching during this period was based as much on persuasion as on rigorous proof. In the third era, medicine is conceived to be *grounded in modern science*.

Some distinguishing characteristics of scientific medicine, according to Flexner, are these: procedures, instruments and drugs are constantly subjected to critical evaluation; speculation is minimized except as a basis for further study; and progress is made through research—accumulation of facts and their analysis. Furthermore, the progress of science and the intelligent practice of medicine employ the same technique —observation, hypothesis (or diagnosis), action, critical review of progress, and perhaps modification. Flexner states: ". . . the student must be trained to the positive exercise of his faculties; and if so trained, the medical school begins rather than completes his medical education."

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Without being too specific, one can confidently predict that the dynamic state of knowledge and its demands upon physicians will occasion other significant trends. Changes may be expected in premedical education, in the preparation for clinical medicine, and perhaps in licensure procedures. The ground swell of science will be felt in all aspects of medical education and service.

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The Regional Medical Complex

The overall picture is one of transition in the ways that medical services are de-

ployed. In some areas of medicine, mission-oriented programs as well as specialized knowledge and facilities may combine to produce specialized institutions deployed more on a regional than a community level. Such major health problems as cancer, heart disease and stroke are amenable to an approach in which these concepts are combined, less as separable entities than as part of a complicated research, educational, service complex.

Such a regional medical center—say, a university hospital or other source of knowledge, skill and equipment—must be characterized by broad scientific excellence, extensive teaching capability, and adequate means for specialized study, diagnosis and treatment of an array of important diseases. Such a center cannot be sustained on a community basis. But medical care of the quality found in our best centers can reach the population at large through related local facilities.

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TAB 52

CHEMISTRY AND COMMUNICATION IN THE BIOSCIENCES*

James A. Shannon, M.D.**

The theme that I agreed to discuss this morning--"Challenges of the Future in Chemistry and in Information Handling" as viewed by the Federal Government--is so broad and so complex that a single individual must confine himself to a limited aspect or to very sweeping generalities. With your indulgence, I propose to undertake both. I should like to speculate briefly about the Federal Government's aspirations in the area of chemistry and communications in the biosciences, speaking with sufficient generality to be valid for most agencies and citing some specific hopes held by those with which I am most familiar.

The presence of a spokesman for the Federal Government on this occasion deserves a word of comment. In all probability, my counterpart of yesteryear would not have played much of a role in such a dedication. But in the last quarter of a century, the force of the Federal establishment in the support of science has increased tremendously. For example, in the area of health and health-related research, the Federal

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* Presented at the symposium of the Chemical Abstracts Service, Ohio State University, June 3, 1965.

** Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

Government's $3.0 million contribution in 1940 accounted for only about 7 percent of the total annual expenditure. In 1965, the estimated Federal component of $1.2 billion represents about two thirds of the total. It might be noted in passing, however, that non-Federal funds have not been driven out of the research marketplace by Federal dollars; private support of biomedical research has increased about tenfold and industrial by about twentyfold since 1940.

In general, the best figures available suggest that the present pattern of support in the health and health-related sciences is not very different from the general pattern for all research and development. The total national commitment to R & D has been placed at about $21 billion for fiscal year 1965, of which approximately 70 percent will be derived from Federal sources. While I am aware that there are those who are concerned about the adequacy of Federal support for the chemical sciences, there can be no doubt that large-scale Federal funding is also characteristic of chemistry.

It is well for each of us to remind ourselves from time to time of the basis for Federal action. Government support is tendered to research and development in order to further specific agency missions established in congressional statutes. The objectives, then, are to accomplish some purpose of the people of this Nation. These include provision for our national

defense and society, our international prestige, and our health and well-being, including the adequacy of food, water and air supplies, the economic security of the citizenry, the education of our youth, and the opportunity for wholesome recreation and rest. In all of these areas, the Executive Departments are identifying and pressing for solutions to interesting and challenging chemical problems in order to fulfill their assigned statutory missions.

It may be noted that my formulation of the raison d'etre for Federal action--that the Government must support the mobilization of science and technology for the solution of human and societal problems--places the emphasis upon applied research and development. This is undeniably true. Even the charter of the National Science Foundation to support basic science qua science might be difficult to justify, as a public enterprise, had not the notion that application ceases with the exhaustion of the mother lode of fundamental knowledge penetrated deeply into the public understanding. Even the NSF's mission looks toward the application of the results of research to public purposes. And yet, it is generally agreed that the Federal agencies, despite their practical orientation, have exercised their power with intelligence and sensitivity.

In the main, science and technology have flourished under Federal sponsorship and have made enormous contributions to

human welfare. Both the Executive and the Legislative Branches have shown keen awareness of the need to support in academic settings a substantial amount of free-ranging research related only obscurely to those applications and developments specifically required for the discharge of governmental missions. More and more the Federal agencies have encountered problems so complex and intractable that an ever-more fundamental level of inquiry is necessary if progress is to be made. Many of these problems I view as the challenge of the future for chemistry.

Let me be specific about some of the health-related problems that fall within the purview of the Department of Health, Education, and Welfare. Within this huge organization are components--the Public Health Service, the National Institutes of Health, the Food and Drug Administration--which in the aggregate bear very weighty responsibilities for the health of the American people and the safety of their environment. Cutting a broad swathe across the organizational pattern of the Department is one central concern: the effect of exogenous chemical compounds upon biological systems, particularly the human organism. Let me explore for you some of the facets of this problem.

A remarkable transformation has taken place over the last 30 years in almost every aspect of the phenomena concerned with the interactions between living systems and exogenous chemical agents. In support of this statement, consider:

--The enormous increase in the known number of biologically active compounds.

--The quantitative increase in the potency of compounds.

--The introduction into the environment of remarkably stable compounds, resistant to biotransformation and degradation, and thus tending to be excluded from, or shunted out, of the cyclic processes of nature.

--The wide dispersion of biologically active agents, capable--advertently or inadvertently--of entering living organisms, including man.

--The tremendous spectrum of biological activities modifiable by currently available compounds. There is a drug available for too much or too little of almost anything you care to name, including id, superego, or libido. Included are agents which modulate the course of chronic disease, and hence are exhibited over protracted periods of time.

--The rapidity with which new compounds are introduced, effectively precluding precise quantification of the biological effects of all but a few, either in absolute terms or in comparison with other agents of the same general class.

--The expectancy, on the part of the public, to be given potent pharmacodynamic agents with ever-increasing frequency and on the basis of ever more trivial indications.

Within this encapsulation of the recent history of a branch of chemical science resides a goodly fraction of DHEW's responsibilities--namely, to guarantee the safety and efficacy of drugs; to assure the purity of foods, and specifically their freedom from harmful additives, pesticide residues, etc.; to maintain the potability of water supplies at high standards; to insure the purity of air we breathe; etc. These needs, which appear on first appraisal to be entirely attributable to the inherent dynamics of the chemical sciences, are actually a manifestation of profound social change, due to intensified industrialization (including that of agriculture), urbanization, and the consequences of these phenomena in terms of transportation, housing, food processing, and other requirements.

The myriad of problems which exist in this area are being tackled, in a more or less systematic sort of way, and empirical evidence is being, or will be, gathered to clarify what specific biological effects can be attributed to each new compound classifiable as now a candidate drug, now a water pollutant, now a component of smog, or the like. But will it be forever necessary to study these entities by the classical empirical methods which, even though the best we have, leave so much to be desired? Or can we hope for the development of a level of insight and understanding that will permit formulation of broad general predictive laws?

Biologists have long attempted to correlate the biological effects of compounds--including those both therapeutic and toxic for man--with their structural characteristics. Success in this enterprise would yield several rewards. In the first place, new insight would be provided into the biological system effected. Here, I am assuming that biological phenomena of whatever complexity will eventually be describable as an array of chemical reactions, proceeding according to known or knowable physical and chemical principles, organized into interrelated systems and subsystems of ever-increasing complexity, the behavior of large segments of which constitutes the elements of biological processes ranging from muscle contraction, bone formation, enzyme synthesis through cell regeneration to sleep, learning, etc.

The examination of the biological effects of exogenous compounds can thus be viewed as a heuristic method of probing into the chemical anatomy of the biosystem, and inferring from the fact of interaction, the nature of the intrinsic processes affected. This approach is highly characteristic of modern pharmacologic and therapeutic research workers as they seek to understand the mechanisms of action of new compounds. But far more may be at stake than simple understanding, which is but the precondition for control--for the design of new and more effective compounds, for the a priori identification of

undesirable ones, for the detection of the presence of an environmental contaminant.

These efforts to correlate biological action with chemical structure have, over the years, been modestly successful, especially within narrow ranges of compound variability and biological response. But we are still a long way from the powerful generalizations required by the exigencies of modern times. In the exploration of this enormously challenging problem, some biological scientists--and perhaps this is simply a measure of our naïveté--are beginning to wonder if they see the possibility of a convergence of this stream of inquiry upon another mentioned in the title of this symposium, namely the handling of chemical information.

The modernization of methods to handle chemical data has been under intense investigation in recent years, and the American Chemical Society's Chemical Abstract Service has been in the forefront of this field of research. One approach of considerable interest seeks to develop methods whereby the structural representations of compounds--the linqua franca for communication about them between members of the chemical professions--can be represented in a machinable form that is unique and unambiguous. To many of us, the availability of a technical capability to search, rapidly and inexpensively, the entire file of known chemical compounds--or some large fraction

of it--with a wide selection of options with respect to search strategy and to substructure specification, seems to offer the first real hope that a new level of sophistication can be achieved in this quest for correlating biological activity and chemical structure. A most important tool would have been created, which in combination with empirical research, might prove powerful in improving experimental design and in telescoping the time scale of progress in this field of inquiry.

Fortunately, the problems occasioned by the expansion of chemical literature have stimulated much interest in the possible machinability of chemical data. There is good reason to assume that we shall soon be able to apply machine processing techniques to perform searches that encompass all of the data implicit in structural drawings, that can retrieve any arbitrarily chosen substructural configuration, and that are independent of the conventional groupings of most fragmentation classification schemes. Thus, as machinable text becomes available over the next few years, it will be possible to explore, with a power and scope heretofore undreamed of, the validity of the hypothetical framework in which we have been working--to wit, that biological activity can be related to structural features implicit in planar diagrams.

The major impediment to progress may well turn out to be not the methodology for the machine processing of chemical

information, but the techniques for handling by automatic means the much 'softer' biological data with which, at the most elementary level of analysis, the structural information must first be correlated.

Certainly, this hypothesis is already known to be of limited usefulness. The specificity of biological reactions, expecially their known dependence upon the enormously complicated structural features of macromolecules, evolved over the astronomical time scale, suggests that the biological activity of compounds, exogenous or endogenous, will turn out to depend on structural properties far more subtle and elusive than those implicit in planar representations, whose information content already taxes the present practical capability for machine handling.

Since I know so little about those aspects of the problem that are specifically chemical and computational, I can imagine, as I peer into my crystal ball, that I vaguely discern problems that surely constitute most exciting challenges of the future to chemistry and information handling. I dimly foresee the day when the typical biochemical laboratory will have, in addition to its traditional instrumental ensemble, a powerful console--one through which a vast repository of chemical data can be interrogated; upon which biosystems can be simulated through the use of models of ever-increasing complexity and sophistication;

and through which solutions to problems may be generated in output formats and displays of great simplicity, elegance and relevance. Thus, biochemists will oscillate between the classical processes of observation, measurement and critical experimentation on the one hand, and the new approaches of simulation and model building on the other. This style of research will come about if and when the promise of new technologies for information processing has, by its realization, erased certain traditional distinctions--those between the state of knowledge in a science, or more specifically, that fraction of its content immediately available to individual scientists, and the state of the archive of that science.

And when the chemical sciences have met these challenges, the Department of Health, Education, and Welfare will certainly find it far easier to discharge the public responsibilities with which it has been charged. For example:

--It will no longer be necessary to worry about whether a candidate drug which appears so promising carries with it a small but finite potentiality for inducing major toxic responses. Drugs of this character would have been screened out of consideration at a very early stage of development.

--The pollution of air, river, stream and field by compounds capable, in time, of adversely effecting some

human biochemical systems will no longer be countenanced, since the means will be at hand to anticipate with accuracy the consequences of well-intentioned but ill-advised attempts to modify man's environment.

--Advances in food processing technology can be enjoyed without reservation or restraint, secure in the awareness that available knowledge can guarantee that no danger, say, of a carcinogen in an additive, or a mutagen in a fungicide residue, is lurking in the background.

--The description of molecular diseases will no longer be confined to a short few chapters under such designations as Hemoglobinopathies and Inborn Errors of Metabolism. All disease will be at least understood at the level of chemical pathology, anatomical and functional, and efforts will be under way to derive from this understanding a rational series of interventions to preserve or restore the status quo.

--On the darker side of the ledger, much of the terror will have been removed from the threat of chemical warfare, for the vulnerabilities of biosystems, especially human, will have been thoroughly catalogued, and countermeasures will have been planned on the basis of certainties.

I have spoken thus far of the aspirations that the Federal agencies responsible for the health of our people have for the chemical sciences. While I feel relatively at ease in laying before you the kinds of new information and information systems that are required to ensure a high level of national health, I cannot speak with comparable assurance about the requirements of other Federal programs. I am sure, however, that the architects of our national security program, for one, are as unwilling as I to dream little dreams, to limit horizons to journeyman levels. Throughout the vast reaches of modern technology encompassed by the defense establishment, problems and challenges in chemistry abound. To expect the officials charged with such awesome responsibilities to be satisfied with less than having pushed technology to its most advanced limits is to underestimate severely the dedication and imagination of these devoted public servants. ¶ And so it is throughout the Federal establishment. The National Aeronautics and Space Agency, the Atomic Energy Commission, the Department of Agriculture, the Department of Commerce, and many others are deeply dissatisfied with their ability to discharge their statutory missions, to meet their public responsibilities, to do their part in the construction of a Great Society. Each will be presenting to the chemical sciences a series of challenges, many more exacting than those I sketched as related to the concerns of the Department

of Health, Education, and Welfare.

Were I more knowledgeable about these matters, I might speculate more realistically about the needs for information handling that will accompany the growth of chemical research and development. This much at least is apparent: the new knowledge that will, and must, be generated in the next quarter century will challenge the imagination and ingenuity of the chemical documentalists. The emerging technical capabilities to which I have already alluded suggest that the art of chemical documentation will be in a state of violent ferment. The very existence of new systems for information processing will undoubtedly force a reassessment of traditional methods and techniques of documentation. The new techniques must be looked upon with an open mind and a sharp eye for real opportunities to the science of chemistry and its application, while the traditional methods must be cherished for their true worth and not out of sentimental attachment or irrational resistance to change.

Looking again at my clouded crystal ball, I see us on the threshold of a great creative forward thrust in almost every aspect of chemical documentation and chemical information processing. If dialogue in depth could be established between the informational documentation community and the research scientists, and thus a basis established for the design of

information systems directly applicable to the real problems in the chemical sciences, a period of truly exciting experimentation and innovation could be anticipated.

There can be no doubt that the current pressure of work is, of itself, forcing the documentalists to modernize their methods for carrying out their traditional functions and rendering their conventional services. In the area of the biomedical literature, the National Library of Medicine, a lineal descendant of the organizations that have been responsible for maintaining bibliographic control over this body of documents since about 1870, has succeeded impressively in developing a mechanized system for preparing the Index Medicus. The early work to explore extension of the present and potential capabilities of this system--MEDLARS--to provide rapid and precise access to indexed documents seems most promising.[9] The present state of the computer art can probably be exploited to provide scientists cheaper, faster and better bibliographic and abstract services than are now available, including a variety of repackaged core materials tailored to the specific needs of individuals or groups. These new services in themselves may well increase the probability of the appearance of review articles. But these techniques, however valuable, are not novel in principle; they perform classical tasks in a somewhat more efficient way while handling a much expanded load. Beyond these, one hopes for

the realization of a dimly perceived potentiality, coming much later and after much intellectual labor--a completely revolutionary development in chemical information processing, so powerful that, incorporated into the warp and woof of the discipline, it will extend chemistry's penetration of natural phenomena to a new and presently unimaginable degree.

The formidable responsibilities borne by public officials are of a nature to justify, and indeed to require, that the Federal agencies encourage these developments and exploit each success to the hilt.

Thank you.

TAB 53

THE ROLE OF THE NATIONAL INSTITUTES OF HEALTH IN SUPPORT OF RESEARCH AND STRENGTHENING NATIONAL BIOMEDICAL CAPABILITIES

Statement by
James A. Shannon, M. D.
Director, National Institutes of Health

before the
Subcommittee on Employment and Manpower
Senate Labor and Public Welfare Committee

June 7, 1965

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I appreciate both the invitation and the opportunity to testify before this Committee on matters related to the impact of Federal research and development policies and scientific and technical manpower.

Dr. Dempsey, the Special Assistant to the Secretary for Health and Medical Affairs, is scheduled to appear before you on June 9 and at that time will present the Department's views on these matters. Consequently, my comments at this time will be confined to the impact of biomedical research, training, and related activities funded by the National Institutes of Health.

Mission

The National Institutes of Health has, as its primary mission, the support of medical research. In the furtherance of this mission, it has come to play a major role in the support of research in institutions of higher education in our country and through this an indirect though major role in graduate education as such. From the beginning it was recognized that effective support for research carries with it the obligation to enlarge the resource base for continued growth in the future. As a consequence, NIH programs have provided fellowships, have strengthened the structure of graduate education

in health-related fields, have provided stable support for faculty expansion, and have stimulated the construction of health research facilities through a matching grant program. This broad spectrum of research and research related activities has drawn the National Institutes of Health into even closer and increasingly fruitful relationships with educational institutions. We have become increasingly aware of the capabilities of Federal programs to (1) support research and, at the same time, to strengthen rather than weaken the educational enterprise and (2) broaden the nation's base of biomedical excellence in all regions of the country through specific programs purposefully planned to achieve this objective.

Before addressing myself to these important matters and the questions of most urgent concern to the Committee, I should like to sketch briefly the scope of NIH's statutory authority, the current composition of our programs in educational institutions, our relative contribution to Federal support for research in educational institutions, and the interrelationships between support for research, itself, for strengthening the broader institutional environment, and for the enlargement of resources for the future.

Statutory Authority

The basic statutory authority for NIH programs derives from the statutory responsibility of the Surgeon General of the Public Health Service for the conduct and support of research and investigations related to the diseases and impairments of man and other health problems. The general authorization for this purpose appears in Section 301 of the Public Health Service Act as enacted in 1944. Subsequent legislation has provided further authorization for the conduct and support of specific research in categorical and other designated areas of research through the establishment of individual institutes with their related advisory councils and by other means.

Gradual Growth in NIH Share of Total Federal Support for Research in Universities

NIH appropriations have grown steadily since 1945, rising from $2.8 million in that year to roughly $1 billion this fiscal year. In 1945, NIH activities were restricted almost exclusively to intramural research in our laboratories at Bethesda with only $171,000 or 6 percent of total appropriations being spent for extramural programs. Although, the intramural research activities on the Bethesda campus have grown steadily, the extramural programs have expanded at a much more rapid rate, with the increases being particularly striking during the past decade. Expenditures through extramural programs for research, training, and construction grants now account for nine-tenths of the NIH dollar.

As a consequense of this progressive and rapid growth, NIH funds now account for 40 percent of total national expenditures for medical and health related research; more than one-third of Federal research funds made available to institutions of higher education; this compares with 9 percent in 1952 (Chart 1). At the present time NIH has a substantial investment in university research and, thus, a basic concern with their capabilities for further growth.

As a consequence, we have become increasingly concerned with assuring:

(1) An adequate supply of well-trained manpower for research and graduate education in the biomedical sciences;

(2) An adequate level of investment in health research facilities to remedy current deficiences and provide for future needs;

(3) Mechanisms for the more general support of research and research training related more closely to institutional capabilities and aspirations; and

(4) More effective planning of NIH programs and more imaginative collaboration with other Federal agencies, especially in the upgrading of existing institutions and the development of new centers of excellence.

(5) Flexibility necessary to accelerate the application of new knowledge to diagnosis and therapy and to mount developmental programs utilizing more fully the capabilities of industrial contractors.

An Adequate Supply of Well-Trained Manpower

In recognition of the future requirements for manpower for health-related research activities, the National Institutes of Health supports graduate postdoctoral training in the health sciences through fellowships awarded to individuals and training grants awarded to institutions. Training grants have aided institutions in developing new programs in the health sciences, thereby substantially broadening the geographic distribution of graduate and postdoctoral capabilities. This experience has encouraged other Federal agencies to utilize the training grant mechanism pioneered by the National Institutes of Health. In my view, this mechanism provides critical leverage because investment in academic

strength represents the point of maximum leverage in the educational process. The faculty transmits knowledge, instills competence, and evokes the spirit of inquiry that must provide the essential foundation for research training. Roughly one-half of NIH training grant funds are spent by the institution for faculty salaries, equipment, supplies, and other items essential for the effective performance of their research training programs; the other half is used for stipends awarded by the institution to graduate students and postdoctoral fellows.

Through a series of interrelated programs, NIH also provides support for career development of biomedical scientists and advancing the skills and capability of mature scholars and practitioners. These are career retention programs with respect to our total scientific labor force; they are designed to enlarge the supply and enhance the quality of biomedical manpower. Beyond the needs of research, this expansion is sorely needed to staff more than two dozen new medical schools and graduate centers to be created in the decade ahead. As these staffing requirements are met and as the new institutions thrive and flourish, regional disparities will be diminished.

Investment in Health Research Facilities

Since 1956, NIH has awarded $320 million in matching grants to 400 different institutions in every State of the Union for the construction of health research facilities. Health Research Facilities legislation authorizing this program stipulates that due consideration be given to

equitable geographic distribution and to the needs of established or promising research activities in areas of the Nation having relatively limited facilities for research. Consequently, the objective of the program has been, and still is, to broaden and strengthen the Nation's health research capabilities, and to contribute to the development of strong institutions in all regions. Table 1 presents a geographic distribution of all NIH research facilities awards by Census region through December 31, 1964. In recognition of the Nation's continuing and expanding needs, the Administration this year has proposed continuation of the NIH Health Research Facilities program at increased levels of Federal support.

In making health research facility awards, NIH will continue to give due consideration to areas having relatively limited facilities for research. But even after awards are made, the visible impact upon research capacity may be delayed as long as a decade. For example, analysis of HRF program experience since 1956-57 reveals that, on the average, more than three years elapse between the award of an NIH facilities grant and the time the facility is completed and ready for use (see Table 2). An additional delay of about two years is then required to assemble staff and fully develop the programs housed in the new space; during the next five years research and training activities will evolve in response to scientific opportunities and educational needs. Because long lead-time slows down the rate of development, a special premium should be placed on long-range planning by States and institutions seeking to enlarge their contribution to the Nation's health research efforts.

There are two other problems which bear pointedly upon the geographic distribution of health research activity. In some instances, matching requirements impede poorer or weaker institutions from upgrading their research capacities. In other situations, authority is needed to construct specialized regional or national facilities to meet broad national needs.

Mechanisms for the More General Support of Research and Research Training

During the past five years, NIH has evolved a set of mechanisms which provide more general support for research and research training, thereby enabling institutions in all regions of the country to strengthen capabilities consonant with institutional objectives. General research support grants provide eligible institutions with flexible funds to be used at their discretion to strengthen their research and research training capabilities in fields related to health. This program was authorized by P.L. 86-798 which provides that a portion of NIH research grant funds, not to exceed 15 percent, may be used for the general support of research and research training in public or non-profit universities, hospitals, laboratories, and other non-profit research organizations. These funds can be used, at the institution's discretion, to develop new departments, to finance central research services, to provide faculty support, to aid students, to provide "seed money" for testing new ideas. This program, now limited primarily to health professional schools, is being extended to other non-health professional components of selected university grantees. We are also pioneering in a small program of awards to develop biomedical centers of excellence.

In the development of new geographical centers of excellence, however, it is essential that the institution retain full control over its education, research, and service activities. Institutions must be free to direct their own development and rate of growth. Federal programs must be designed to strengthen the organization, integrity, and unique character of each institution. The further expansion of general research and training support, for example, will serve to center the responsibility for graduate education in the institution itself.

Changing Geographic Distribution

Three dominant trends characterize the changing geographic distribution of NIH grants over the past 15 years:

1. Dispersion: One gross measure of dispersion of NIH awards is reflected in the number of institutions in each region of the country receiving more than $1 million in NIH grants, rising from one institution in 1952, to 17 in 1957, 68 in 1962, and 79 in 1964. This change is expressed in constant dollars.

2. Regional shifts: Significant shifts in the regional distribution of NIH funds have occurred. For example, ten years ago, institutions in the South, Southwest, and Far West received about 30 percent of NIH research grants; in 1964 these regions accounted for 37 percent of the total. More significant than this percentage shift, however, is the steady spread of biomedical research capability into all regions of the country, with more than 77 institutions in 37 States receiving more than $1 million in NIH awards in 1964.

3. State shifts: Since 1948 there have been significant shifts in the proportion of NIH funds awarded to institutions located in the 50 states. Institutions located in more rapidly growing states such as Florida, Texas, and California received a progressively larger share of NIH funds. At the same time, educational institutions located in states such as New York, Pennsylvania, and Illinois received a smaller share of the total in 1963 than in 1948. On the other hand, institutions located in states such as Connecticut and New Jersey bucked the regional trend and received a larger share in 1963 than in 1948.

Thus, it appears that the geographical distribution of NIH funds broadened between 1948 and 1963. In interpreting these trends, it should be noted that there is not a 1-to- relationship between the distribution of funds to institutions and that to states. Whereas, for example, Wisconsin ranks 15th in the state distribution, the University of Wisconsin ranks 11th. Also, it sould be recalled that great national institutions draw their students from the 50 states, constituting international centers of excellence and that geographical distributions which attribute the national institution to its state are somewhat inaccurate. Finally, the broader geographic distribution of NIH funds reflects (1) a visible decline in concentration of funds among the top 25 institutions, from 50 percent in 1948 to 42 percent in 1963; (2) considerable change in the composition of the 25 institutions receiving the most NIH funds, 8 institutions appear on the 1963 list that were not on the 1948 list; and (3) the impact of research facility construction and the training programs in developing institutional capabilities.

Economic Impact

NIH funds for research and the construction of research facilities have, of course, a marked and immediate impact on the economy of the regions where these dollars are spent--in terms of the employment of persons directly engaged in the research and the employment of service and other personnel to furnish the goods and services to maintain the research community. These effects are similar to the results in any locality where governmental funds are provided as a new or added "input" to the region.

But research supported to advance knowledge for the conquest of disease and disability by its very nature is different from the much larger expenditures for research and development by the Department of Defense, the National Aeronautics and Space Administration, and the Atomic Energy Commission--since NIH programs do not have as their primary objective the development of new and improved products or hardware, calling forth the large-scale employment of production workers to produce newly developed end items.

(It is certain, however, that as we look ahead to the near-term future of biomedical research, the involvement by industry will become greater with increased employment of the research capabilities of industry in applying engineering techniques to the solution of biomedical problems.)

In addition to the immediate impact of research funds on a community, the very existence of a research capability--manpower and physical facilities--provides for possible future regional growth and evolvement in the search for new knowledge, and in the capability for training new talent.

But the economic consequences of medical research go far beyond the direct and immediate impact of research expenditures on the economy of a region, or of the Nation. Death and disability take an enormous toll of productive resources, provisions for health care and services are a necessary but largediversicn of resources that, conceivably, could be used for other social ends.

It must be emphasized again, however, that the basis for our Nation's support of biomedical research is the control or eradication of disease and disability--and economic considerations are necessarily only secondary to this broad humanitarian objective. Nevertheless, we would be remiss in our duties as administrators of a large scale governmental program were we not to consider the economic consequences thereof.

Regrettably, the attention of economists and others has only to a very limited extent been focused upon this central question--namely, the impact of medical research on the economy. I have, therefore, directed my staff to undertake exploratory investigations with leading social scientists to determine what can be done to understand, measure, and plan for the economic consequences of medical research.

More Effective Planning

As NIH programs have grown in scope and complexity, we have directed increasing effort toward developing a framework for more effective planning. The recent report of the Wooldridge Committee to the President, while praising the quality of NIH programs, also emphasized the need for long-range planning.

The directions in whichFederal support for biomedical research should move must be related to an over-all national plan and purpose which, on one side, encompasses activities in the prevention, diagnosis and treatment of disease and, on the other side, includes undergraduate, graduate and professional education and the whole gamut of scientific research activities.

Within this broad context, NIH plays a dual role. By its organizational position as a bureau of the Public Health Service and the legislative language creating the various Institutes, NIH is properly described as a health organization using scientific research for the furtherance of its particular health mission. At the same time, however, because of the nature of its activities and its special relationships with the academic community, NIH can also be regarded as a scientific research organization which has the special mission of concerning itself with health problems. In its role as a health organization, NIH is an important adjunct to health service activities and, as its preoccupation with the creation of a research base recedes, it should be able to give more attention to the need to provide a better link between research results and their practical application. In its role as a scientific research organization, NIH has a significant involvement with university science departments and, as the science base of medical research broadens, NIH will inevitably be increasingly involved in the activities of a wider circle of the scientific community. In this connection, we shall be reviewing the broad spectrum of our research, training, and facility investments with an eye toward maximizing institutional development. NIH has long been directly concerned with the impact of its programs upon the health of educational institutions. Because of this concern for strengthening the

national structure of biomedical research and education, we have attempted to anticipate major developments warranting long-range program planning. Looking ahead, I am intrigued by two predictable opportunities for more effective planning.

First, by 1975, the number of medical schools will have increased nearly 50 percent, as compared with 1945. Between 1945-1960 12 new medical schools were established; at the present time an additional 13 new schools have been authorized. With few exceptions, these new schools are being established in communities and in states lacking such facilities. For each of these areas, Hartford, Providence, Albuquerque, San Antonio, San Diego -- the creation of a new school will entail an average capital outlay of $30 million, ultimately will provide employment for 500 faculty members and about 2,000 supporting personnel, will award 100 M.D.'s annually, will provide graduate and postdoctoral training for 400 students, will train another 200 interns and residents, and probably most important of all -- will greatly enlarge access to high quality medica care throughout the region. In aiding these new and emerging medical centers to realize their full potential, NIH hopes to contribute significantly to the geographic spread of excellence in all regions.

In the development of new geographical centers of excellence, however, it is essential that the institution retain full control over its education, research, and service activities. Institutions must be free to direct their own development and rate of growth. Federal programs must be designed to strengthen the organization, integrity, and unique character of each institution.

The expansion of general research and training support, for example, will serve to center the responsibility for graduate education in the institution itself.

Secondly, I am convinced that voluntary interagency cooperation will facilitate the more effective utilization of Federal resources in adding new centers of excellence and upgrading existing institutions across the country. A start has been made toward this objective, and the feasibility of doing more is being explored. The Federal Interagency Committee on Education (established by Executive Order 11185 of October 16, 1964) provides an over-all framework for such cooperation.

A more deliberate focus on centers of excellence calls for identification of institutions in which agency interests intersect. The need then, is to identify (within this group) those institutions with the greatest potential for excellence, plus the determination to excel. Beyond this--and to the extent possible--the need is to make the impact of agency programs additive in these institutions of promise.

It is possible, of course, that a region may have no institution which today offers promise of the degree of excellence sought. In such case, the objective of interagency cooperation would be to seed several possibilities, and to follow the results.

Such cooperative ventures are, however, limited by differing agency missions and by the need to maintain the integrity of individual programs. In addition, there are problems in agreement on criteria for excellence, and in the mechanisms for selecting one institution over another. In spite of these limitations, much progress has already been made. For example, liaison and information exchange among managers of facilities programs is well advanced

There is also interchange among managers of fellowship programs. We will need increased interagency participation if we are to optimize the use of Federal resources in developing new centers of excellence and upgrade existing institutions in all regions of the country.

Looking to the Future

I think it is clear that the National Institutes of Health, in pursuing its major goal, namely the advancement of the health and well being of the American people through scientific effort, has, as a derivative result, providing for the development of a broad national base of resources for the biomedical sciences. Although our committment to our mission imposes the obligation to place considerations relating to scientific merit and program importance first in our funding processes, the nature of our programs and the manner in which we have approached their administration has undoubtedly contributed substantially to regional development. Looking to the future we are now engaged in a series of new program efforts which, as they emerge will significantly strengthen biomedical capabilities in all regions of the country.

As a consequence of legislation passed in the last Congress, efforts are being directed towards the development of community mental health centers as a new approach to the treatment and care of the mentally ill. In a similar manner we are engaged in a new program to expand the treatment and research facilities available for mental retardation. Both of these programs involve state planning as a means of assuring adequate access to these facilities for the population as a whole. In another area, namely that of providing regional facilities for research involving the higher subhuman primates, the NIH has provided support for the establishment of regional primate research centers to serve regional needs for this kind of scientific facility.

We are now turning attention to advancing research and scientific effort in three other specialized areas in which regional considerations will be important:

1. The Public Health Service is seeking to bring about a new approach to research in aging through the establishment of national laboratories for aging research. These facilities will provide the specialized resources to permit the development of cohesive programs of research centered upon both the biological and social problems of aging.
2. Expansion of the national research effort in respect to the complex problems encompassed within the fields of pharmacology and toxicology is under way. Greater research effort in these areas is crucial to understanding the phenomena of adverse drug reactions, the effect of pesticides and the broad problems of environmental pollutants. We have proposed the development of a series of major research centers to undertake new research and research training programs in these fields.
3. Deliberate effort is being directed towards bringing the full capability of basic science to bear upon the solution of the major problems of dental disease. We have in mind the creation of a series of dental research institutes located in large

university complexes where basic scientists encompassing a broad range of disciplines could cooperate in new approaches to the stubborn problems of oral disease.

These new program ventures will provide further opportunity to expand our regional resources for academic and scientific work important to health and medicine.

These developments, however, present new problems. For the most part, these developments will require major investment in research facilities. Because these activities for the most part can not be encompassed within the usual departmental framework of universities, matching funds for such construction will not be easily available. We therefore will need authority to provide for construction, in the interest of these broad national purposes, under terms and conditions which permit substantially higher levels of Federal financing than is currently available in our health research facility construction program. Such authority is now being sought from the Congress and is encompassed in S. 596 and H.R. 2984.

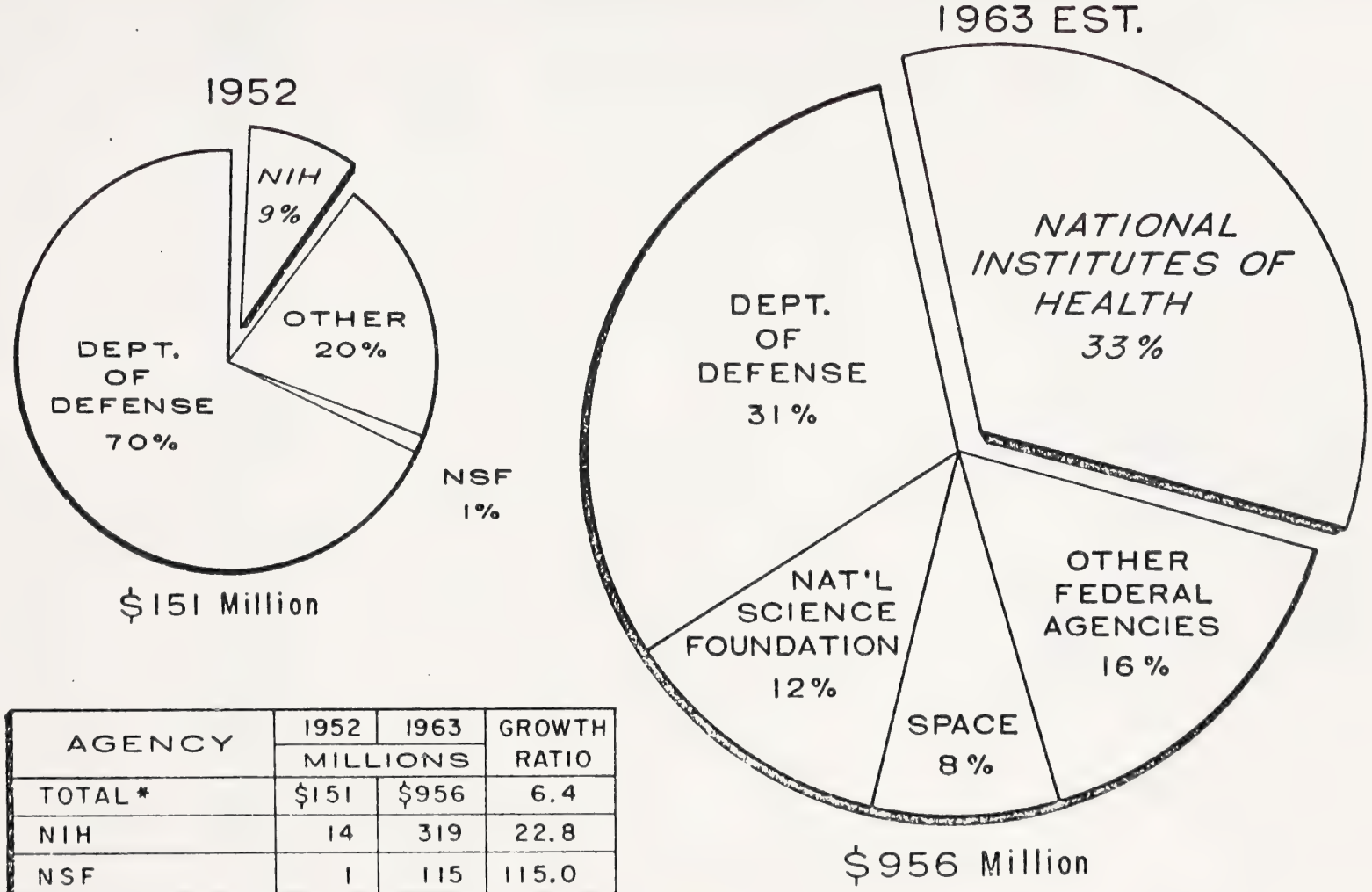
A further development which will have broad national impact is the prospect of greater involvement of industry in the advancement of our several programs. Progress in science and technology in the biomedical area now makes possible the undertaking of deliberate development programs such as the design and development of artificial organs, the production of vaccines for respiratory diseases, and the application of computer technology to broad areas of health and medicine. We will need to make broad use of industrial scientific and technical resources in the conduct of these programs. This expanding engagement with industry will provide a new area

of growth of importance in respect to the concerns of this Committee.

Beyond these developments in the fields of science and technological activity, as such, the broad proposals encompassed in the Report of the President's Commission on Heart Disease, Cancer and Stroke now formulated in legislation before the Congress, will add a substantial new dimension to NIH activities. If this legislation is enacted in its present form we will be turning our efforts to the development of a national program for linking the centers of scientific and academic medicine with community health resources. The implications of this new program are broad indeed.

In closing I wish to emphasize that we at NIH have a keen appreciation of the problems and issues with which this Committee is concerned. It is our belief that in the administration of our programs we have given particular emphasis to the development of a broad and productive national base for advancement of the biomedical sciences. We believe that this structure will contribute substantially and in a lasting way to the growth and progress of all parts of the Nation.

TRENDS IN FEDERAL SUPPORT OF RESEARCH AT COLLEGES AND UNIVERSITIES 1952 - 1963



AGENCY	1952	1963	GROWTH RATIO
	MILLIONS		
TOTAL*	$151	$956	6.4
NIH	14	319	22.8
NSF	1	115	115.0
Defense	106	296	2.8
Other Federal†	30	226	7.5

* Excludes university-managed Federal contract research centers, such as Los Alamos, Argonne, and Jet-Propulsion Laboratory.

† Includes National Aeronautics & Space Administration.

Table 1

Distribution of NIH Awards for Construction of Health Research Facilities, by Region 1957-1964

Region	Amount (thousands of dollars)	Percent
Total	$319,999	100.0
New England	38,184	11.9
Middle Atlantic	72,007	22.5
East North Central	60,948	19.0
West North Central	18,202	5.7
South Atlantic	38,940	12.2
East South Central	13,219	4.1
West South Central	18,102	5.7
Mountain	14,347	4.5
Pacific	45,980	14.4
Puerto Rico	68	.0

Source:
Ninth Annual Report on Health Research Facilities, by the Surgeon General of the Public Health Service; House Document No. 118, 89th Congress, 1st Session, pp. 80.,81.

Table 2. -- Time Relationship: Health Research Facilities Awards 1/ to Project Completions, by Fiscal Year of Award and Number of Years From Award to Project Completion

(Percentage distribution)

Number of years from award to completion of project	Fiscal year of award									
	Total	1957	1958	1959	1960	1961	1962	1963	1964	1965 2/
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1 Year	7.9	3.6	10.4	6.5	4.9	11.6	6.2	10.9	7.7	9.0
2 Years	21.3	21.9	29.4	20.1	12.1	13.9	14.6	20.0	24.5	24.0
Less than 3 years	29.2	25.5	39.8	26.6	17.0	25.5	20.8	30.9	32.2	33.0
3 years	23.4	21.2	31.1	13.4	27.4	22.4	27.9	21.6	23.6	23.0
4 years	25.4	22.0	14.6	35.9	20.8	31.1	29.5	24.1	25.5	26.0
5 years	16.5	8.6	4.2	21.8	34.8	21.0	21.8	17.4	12.8	12.0
6 years	3.4	9.5	3.6	2.3	--	--	--	--	5.9	6.0
7 years	1.3	6.1	6.7	--	--	--	--	--	--	--
8 years	0.8	7.1	--	--	--	--	--	--	--	--
3 years or more	70.8	74.5	60.2	73.4	83.0	74.5	79.2	69.1	67.8	67.0

NOTE: HRF awards for FY 1961-1965 are largely for projects still active; hence year of completion is estimated. Estimates for projects awarded in these years reflect expectations of the HRF Branch that efforts of its office of architects and engineers will facilitate improvement of planning and construction schedules by grantee institutions. The total time span for projects not completed is therefore estimated on a more conservative basis than indicated by actual experience with completed projects.

1/ Includes all awards from beginning of HRF program through December 31, 1964

2/ Includes only the first six months of the fiscal year.

Resources Analysis Branch
Office of Program Planning, NIH
April 1, 1965

TAB 54

=357

JEFFERSON MEDICAL COLLEGE
COMMENCEMENT ADDRESS*

James A. Shannon, M. D. **

Mr. Chai[illegible], President Bodine, members of the Board of Trustees, members of the Faculty, parents, friends of the University, and--most especially--members of the Graduating Class of 1965:

To take part in these exercises today is an honor for which I am particularly grateful and a task which gives me a great deal of personal satisfaction. The graduation of a new class of physicians and allied professionals, by an institution long known for its excellence and high achievement, is always a gratifying occasion--not only for you and your family and friends but for the many people, as yet unknown to you, who will at some time put their faith in the kn[illegible] and skills you have worked hard to acquire and who will benefit from the dedication to their welfare that is implicit in your choice of a career.

Some years have passed since I sat, as you sit now, exhilarated but with mixed emotions. However, I can well remember the joy, the relief, the warm but quiet pride at having successfully come to the end of an arduous road--and I also remember the feeling of sober anticipation, and even of apprehension, for the difficulties that still lay ahead. Diffi[illegible]ties do, indeed, lie ahead. All too often you will be distressingly aware of the gaps in our understanding of biological

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* Commencement address at Jefferson Medical College, June 11, 1965.

** Director, National Institutes of Health, Public Health Service, U.S. Department of Health, Education, and Welfare.

processes, of the uncertainties of diagnosis, and of your inability to combat a disease or prevent a disability. Even so, you should take comfort from the fact that you are very much better equipped to deal with the tasks that await you than my graduating class was not quite forty years ago.

The progress of medicine during the past several decades has been astonishingly rapid. Many infectious diseases have been all but eliminated, at least in this country; new diagnostic techniques, new drugs, new surgical procedures, and new therapeutic devices have altered the patterns of medical practice and greatly enhanced its effectiveness in combating disease and preventing abnormalities. It is an old observation that knowledge begets knowledge at an accelerating rate. The developments of the next forty years--the period of your professional activity--are certain to outrun and outshine the developments of the past. There is every reason to believe that we are entering what may be called the Age of Biology--a period that will be even more revolutionary for the biomedical sciences than the period since the beginning of World War II has been for the science of physics.

No generalization about your future can be made with greater certainty than the assertion that you are beginning your professional career at a time when your chosen field is undergoing rapid changes that will establish new concepts, shatter many existing hypotheses,

evolve new technologies, create new capabilities, and, in the process, uncover new and unsuspected problems. These changes will not merely transform the biomedical sciences but will profoundly alter the practice of medicine and, almost certainly, affect its role in our socio-economic system.

The impetus for the changes in the science of medicine has come--and will continue to come--from the rapid expansion of our national biomedical research effort. To say that the proportion of our total national expenditure on research and development that is devoted to medical research has almost doubled since 1950--rising from a little over 5 percent to about 9 percent--grossly understates what has actually happened. The relationship is badly distorted by the large sums that are now devoted to our space program. A more realistic--and also more impressive--index of the growth of medical research is given by the actual dollar figures. National expenditure on medical research, which amounted to $160 million in 1950, will rise to about $1.85 billion in 1965--a more than eleven-fold increase in just 15 years. This represents an escalation of effort that is having a profound impact on the substance of the biomedical sciences and, therefore, on the patterns of medical education and the potentialities of medical practice.

You, as physicians and professionals in the health field, should not only be concerned about but must actively concern yourself with these far-reaching changes in the medical sciences, whether or not you become directly involved in medical research.

Medicine, as a broad discipline, is becoming increasingly complex and sophisticated as it becomes more deeply rooted in fundamental science. Biology--the mother of medicine--is at last emerging from its relatively primitive state as a predominantly empirical and descriptive science. The physical sciences are being successfully pressed into service for the solution of biological problems. Mathematics, with the aid of computers, is on the way to becoming as powerful a research tool for biomedical scientists as it has been for physicists and chemists now that it is becoming possible to devise mathematical models of biological processes. Refined engineering techniques, particularly in electronics, hold great promise for the development of devices that will add a new dimension to both research and clinical practice. The behavioral sciences are beginning to come of age and to develop rigorous research techniques that, ultimately, will greatly extend the scope of the problems with which the medical practitioner--broadly defined--will be able to deal.

Medical research itself--both in its laboratory and clinical aspects--is less and less confinable to the traditional pre-clinical and clinical disciplinary fields. The majority of today's research projects are focused either on fundamental scientific problems or on disease entities--neither of which fit comfortably into the neat but artificial compartments into which science has hitherto been divided.

These trends--which I have only taken time to sketch very briefly and superficially--have far-reaching implications for the organization of medical education. Departmental structure and curricula, for the most part, still reflect the traditional approach that is becoming less and less relevant to modern medicine. The adaptation of medical education to the demands of tomorrow--if not, indeed, of today--will require a considerable restructuring of the educational process from the pre-medical undergraduate curriculum through internship and residence. The latter, in particular, must in future offer wide opportunities for the new physician, with proper background, to engage himself with the problems of biomedical science. Mere clinical experience and exercise in the art of medicine will no longer suffice to train him for the demands that will be made upon him or to prepare him to exploit the potentialities of the new knowledge that modern research will make available as he continues his career.

The close personal relationship between a physician and his patient will always set medicine apart from the coldly impersonal physical sciences which can, in more than one sense, be described as 'hard sciences'. I do not suggest, therefore, that medicine should ever cease to be, to some extent, an art. But we physicians have, in the past, too often stressed the 'art' aspect of our profession as a cover for the large gaps in scientific knowledge available to us. As these gaps are filled, we must prepare ourselves to act as the scientists which we also profess ourselves to be.

The implications of what I am saying for the newly-graduated physician will not, I think, have escaped you. The increasing complexity and scientific sophistication of medicine means not only that future physicians must be science-oriented and more fully grounded in basic scientific disciplines, including physics and mathematics, but also that more purposeful means must be devised for the continuing re-education and self-development of the practicing physicians. Given an average life span, you--today's graduates--will be practicing medicine into the early years of the next century. It does not strain one's powers of prophesy to predict that in this era, in which yesterday's science fiction becomes tomorrow's science news, the state of medical knowledge of 1965 will not merely be outdated by the year 2000 but will probably appear to be antique. You are thus faced with a serious problem of professional obsolescence.

This, of course, is not a new problem for the medical profession. Abraham Flexner, in his famous report on medical education which he submitted to the Carnegie Foundation in 1910, said that "the student must be trained to the positive exercise of his faculties; and if so trained, the medical school begins rather than completes his medical education". The difference now is not that the problem is new but that it is so much more serious and that the efforts you will have to make to keep up will have to be so much more strenuous and determined than those of your predecessors in the profession.

I suspect that many of you are disappointed that I now seem to be on what is, without doubt, the most hackneyed theme of commencement speakers. Frankly, I should also have liked to avoid it. But I cannot, in honesty, speak to you about the problems you will face in the challenging career that lies before you without emphasizing that its greatest challenge is the obligation you have inescapably accepted to keep yourself abreast of the rising tide of knowledge in your field.

To look upon the completion of your formal academic courses as a beginning rather than an end is more vitally important to the medical graduate of today than to the graduate in any other field or at any previous time. You have, in hard fact, embarked on a course which has no end. The new physician of today--if he is to meet his obligation to society and to himself--can never be released from the educational process. By presuming to minister to the sick and the afflicted you have, in effect, taken a vow to continue to study and to learn until the day that you lay down the tools of our most honorable trade.

Unfortunately, you will get but little help in your efforts to keep this vow. Unless you go into research or join the staff of a major teaching hospital or medical school, the present conditions of medical practice will offer you few opportunities and very little outside incentive for keeping abreast. The demands of your day-to-day

work, of your family, and of your recreational interests--which I should not wish to deny you--will almost certainly leave you less and less time and energy for the pursuit of knowledge which, as you already know, is itself not an easy task.

Yet society demands--and rightly demands--that you must do so. It is conceivable that you will, at some future time, be subject to periodic re-examination to retain your license to practice as society seeks ways of ensuring that the medical profession will consistently provide the best medical care which the science of medicine can then currently offer. If and when such a proposal is seriously made, you should not regard it as a threat to your independence or an infringement of a right you have already won. You should look upon it as a spur and as a protection--not merely of the public interest but of the standards of your calling and of your own professional integrity.

Perhaps we can also hope that society, in insisting on the highest quality of medical care, will also accept an obligation to provide you with adequate opportunities for your continued education and for making the results of research and the improvement of techniques more readily and quickly available to you, wherever you may be professionally active.

This is, in fact, the principal aim of the recommendations recently made by the President's Commission on Heart Disease, Cancer and Stroke. The necessary legislative authority for implementing some

of these recommendations is now under consideration in the Congress and will, I think, be acted upon before the end of this session. All the details of this program--for which the National Institutes of Health will have primary administrative responsibility--have not yet been worked out and its ultimate character will have to be evolved from experience as the program develops.

The initiation of such a program will, however, have a significant effect on the way our national medical services are deployed.especially insofar as the practicing physician can be associated, on a regular basis, with our major centers of excellence. This is one further symptom of the transitional phase in which the field of medicine finds itself as you join its professional ranks.

In some areas of medicine, disease-oriented programs may be combined with fundamental science programs to create specialized institutions with comprehensive modern facilities to serve the medical communities of much wider regions than those that now have access to centers of research. Major health problems such as cancer, heart disease, and stroke are amenable to an approach in which basic science and clinical concepts and approaches are combined in a comprehensive research-educational-service complex.

Such a regional medical center--say, a university hospital or other repository of knowledge, skill and equipment--must have broad scientific excellence, extensive teaching capability, and adequate means for specialized study, diagnosis and treatment of an array of major diseases. Such a center cannot be sustained on a community basis.

But medical care of the quality found in our best centers can reach the population at large through associated local facilities.

The concept of regional networks, which are likely to vary considerably in character in response to local needs and conditions, is emerging for several reasons. It is a natural outgrowth of specialization and the growing complexity of diagnostic and therapeutic procedures in many fields. More important, it opens a channel to the continuous outflow of information useful to the physician in the community as he approaches his daily, increasingly difficult professional problems.

The evolution of the regional medical complexes clearly cannot proceed satisfactorily without the active cooperation of the medical profession, the public, and the agencies that will support them in furtherance of their public missions. The voluntary health agencies, Federal research programs, and State and local health departments must be wholeheartedly involved. A network of community centers of excellence closely linked to common sources of new medical knowledge, could usher in a whole new era in disease control.

The glimpses I have tried to give you of some of the currents that are changing the course of medical practice may, perhaps, seem somewhat disturbing to you. They should not be. Medical science is entering a new dynamic era that holds out the promise for each of you of stimulating intellectual challenges and rewarding opportunities for service to your fellow man. I envy you as you leave here today to embark on an exciting career that will, I am sure, prove to be the most satisfying you could have chosen.

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